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THE RAILWAYS AND THE FORESTS

In Mr. Smythies' interesting description of the system adopted by the United Provinces Forest Department for supplying sleepers to Railways, he expresses his astonishment that there has been so little co-ordination hitherto between the two Departments in some other parts of India.

The implied criticism is not unjustified ; attention was drawn to the same thing by the Sleeper Enquiry Committee (*vide* Report of the Sleeper Enquiry Committee, 1923-24, by F. W. Allum and R. N. Parker. Price Rs. 1-12-0. Government of India, Central Publication Branch, Calcutta). But it would be wrong to conclude that there has been no movement towards co-operation or to infer that the solution necessarily lies in an extension of the United Provinces system to the other provinces.

In most provinces the Forest Department now sell some sleepers direct to the Railways. But only in three, the United Provinces Bombay and Assam, can these arrangements yet be called a factor of much importance in sleeper supply.

In the past, co-operation has been closest and most successful in the United Provinces and Bombay. In these two provinces, Government owns practically all the forests that can produce sleepers ; doubtless the fact that the Chief Conservators and Chief Engineers concerned are consequently in a position to control sleeper prices by mutual arrangement has made the advantages of co-operation more obvious there than elsewhere. Assam is another province where the Railways have recently

bought considerable number of sleepers direct from the Forest Department: there, too, we find that most of the forests that can produce sleepers are Government reserves, although the proportion of private forest is larger than in Bombay or the United Provinces.

But in India generally, the Forest Department (by which is here meant the Forest Department in British India) has a smaller share in the output of sleepers than is usually realised. This was pointed out in paragraph 44 of the Sleeper Enquiry Committee's report; but perhaps the following attempt to tabulate the main sources of Broad Gauge and Meter Gauge supply will bring it out more clearly :—

Main sources of sleeper supply.	Species of sleeper.	Approximate number of sleepers produced per annum in Government forests in British India.		Approximate number of sleepers produced per annum outside Government forests in British India.	
		B. G.	M. G.	B. G.	M. G.
Kashmir, Punjab and Hill States.	Deodar ...	90,000	50,000	900,000	200,000
United Provinces, Nepal and N.-W. Behar.	95 per cent. sal, 5 per cent. deodar.	25,000	375,000	360,000	125,000
Assam, Bengal...	Sal and *nahor* (*Mesua ferrea*).	100,000	80,000	20,000	90,000
Behar and Orissa (except N.-W. Behar)	Sal ...	80,000	80,000	160,000	110,000
Central Provinces and Sal forests in North of Madras Presidency.	Sal ...	40,000	70,000	160,000	90,000
Southern India...	Teak, *irul* (*Xylia xylocarpa*), *nangal* (*Mesua ferrea*), *irumbogam* (*Hopea parviflora*), *karumarudu* (*Terminalia tomentosa*).*	25,000	140,000	100,000	140,000
TOTAL ..	...	360,000	795,000	1,700,000	755,000

* *Karumarudu* (*Terminalia tomentosa*), which has a very short life unless treated, is not accepted by most Railways.

These figures are of course only rough estimates, as the demand and output fluctuate considerably from year to year, but they are near enough to the actuals to give a general idea of the position.

Imported wooden sleepers, including Burmese teak and *pyinkado* (*Xylia dolabriformis*) are omitted, as this note deals only with supplies from India. But it may be mentioned that Burma produces about six lakhs of sleepers a year of which about two lakhs are exported to India.

Only the standard kinds of Indian sleeper woods which are used without preservative treatment have been included in the list. (Three to four lakhs of sleepers are treated per annum by the North-Western and Dibru-Sadiya Railways in their sleeper treating plant at Dhilwan and Margherita). If the use of treated sleepers develops in India, the Forest Department's share in the total sleeper supply will increase, for there are extensive Government reserves of coniferous forest in Northern India and of mixed forest in Madras, Coorg, Bombay, Assam, Eastern Bengal and the Andamans, which have hardly been touched yet. But there are also considerable areas of similar forest outside our reserves (*e.g.*, in Mysore, Cochin, Travancore, Kashmir, Tehri-Garhwal and other hill states), and it is certain that forest owners other than the Forest Department in British India will supply a great proportion of India's sleeper woods as long as wood is used for sleepers. Co-operation between these other forest owners and the railways is equally desirable and in some instances has been effected; but the purpose of this note is to consider the lack of co-ordination between the two Departments in British India, of which mention was made in Mr. Smythies' article. No matter whether the Forest Department's share in sleeper-supply is large or small, it is obvious that they and the Railways ought to work together as much as possible. The following notes on sleeper production in different parts of India, and of the different methods devised by the Forest Department for adapting their sleeper operations to suit local conditions, may therefore be of some interest. It has been compiled from information kindly given to the writer by the Forest Officers he has met in the different

provinces, to whom he is also greatly indebted for the opportunities they have given him of seeing the operations in progress.

UNITED PROVINCES.

The system in force has already been described by Mr. Smythies; and the following summary is merely to emphasise the main features which distinguish it from the methods followed elsewhere.

Ordinarily, about 90 per cent of the sleepers that come from the U. P. are made by forest lessees working in the Government forests. The U. P. forest leases are numerous but small and are usually given out on annual contract. Sal is the chief sleeper wood, deodar sleepers being only produced from one division. *In this part of India there is a good public demand for sal* and deodar timber in other than sleeper sizes. Shortly before the forest auctions the prices and numbers of sleepers to be supplied during the coming year are settled between the Forest Department and the two Sleeper Groups concerned. The Forest Department then make it a condition of their forest contracts that so many sleepers are to be supplied by each lessee. There is no formal contract, with penalty clauses, between the two Departments; since the system was started, about ten years ago, the arrangements have always been settled by informal agreement, with results that have on the whole been very satisfactory to both parties.

In eight of the U. P. divisions which supply sleepers they are passed by the Forest Department; in the remaining three the passing is done by the Railway Company's passing officers.

The sleepers are paid for almost immediately after passing. Those which are passed by the Forest Department are paid for by the Divisional Forest Officers out of funds placed at their credit for the purpose by the Railways; and the Divisional Forest Officers, as disbursers on behalf of the Railways, send monthly accounts to the Chief Auditors concerned. It will thus be seen that no provision has to be made in the Forest Budget for funds for buying the sleepers from the forest contractors.

The Forest Department make no direct profit on the transaction. There is however an indirect profit, due to the fact that the Department's lessees bid good prices for forest leases which carry with them firm orders for sleepers that are to be paid for on the nail.

Most of the U. P. forests are served by Meter-Gauge lines and the sleepers supplied by the U. P. Forest Department are nearly all Meter-Gauge, the annual output at present being between 3½ and 4 lakhs. The Railways that look to Northern India for Broad-Gauge sleepers get the bulk of them from Nepal (sal) or from Kashmir and the Punjab (deodar).

The U. P. system works very well with the Railways that have become accustomed to it; but difficulties sometimes arise when supplementary indents for sleepers or other timber are accepted from other Railways, whose Chief Auditors are not accustomed to the method of financing the operations. For supplementary supplies of this kind, especially if undertaken at rather short notice, the Assam system is perhaps preferable.

ASSAM.

The accepted standard sleeper woods of Assam are sal and *nahor* (*Mesua ferrea*). But in the north-east of the province the Dibru-Sadiya Railway have a sleeper-treating plant and can, therefore, use other species as well. The Government reserves produce nearly all the *nahor*; but private forests have a considerable share in Assam's output of sal sleepers. There is a considerable export of sal timber in other sizes besides sleepers.

There are three systems of sleeper supply in force at present in the Government forests :—

(*a*) Purchasers of standing timber supply sleepers to the railways without the intervention of the Forest Department.

(*b*) Sleepers are made departmentally and sold to the Railways at prices previously settled by informal agreement.

(*c*) Sleepers are bought from forest lessees and paid for by the Divisional Forest Officers, as in the U. P.

But the funds for the purpose are not advanced by the Railways. They have hitherto been provided for in the Forest Budget under A. I. And after the sleepers have been made over to the Railways, the payment for them has been shown under R. I. The Forest Department have made a small direct profit on the transaction by buying the sleepers from their lessees at slightly less than the price paid for them by the Railways. As objections have been raised to this system on the grounds that it unduly inflates expenditure and revenue it has been under consideration whether to provide for the required funds under the new head of Advances A. X. The Assam Forest Department also contemplate foregoing the small direct profit that they have been making on the transaction, as it is considered that the revenue realised thereby must entail a corresponding reduction in the prices bid for the coupes at the auctions,—in other words, that it does not make the slightest difference to the Forest Department's revenues whether they buy the sleepers from their contractors at the full price paid by the Railways or at less than the full price.

It will be seen, therefore, that the Assam system of financing the operations differs entirely from the U. P. system, although in practice the arrangements appear very similar.

As regards passing, the present arrangement is that the Forest Department passes all the sal sleepers for the Eastern Sleeper Group. But the *nahor* sleepers, which go to the Assam Bengal Railway, are passed by the Assam Bengal Railway's passing officers.

The Assam Forest Department supply about a lakh of sleepers per annum direct to the Railways. The agreements made between the two departments are informal, as in the United Provinces.

Bombay Presidency.

In Bombay Presidency practically all the forests from which sleepers are obtained are Government reserves, and there are three methods of supply in force.

(*i*) Purchasers of standing timber supply sleepers to the Railway Companies without the intervention of the Forest Department. The number of sleepers so supplied is inconsiderable.

(*ii*) Since the year 1921, purchasers of standing timber have been allowed to pay for their timber partly in cash and partly in the form of sleepers delivered to the Railway Company: for such sleepers the Forest Department receive payment in full from the Railway Company and credit this amount, less a small fixed amount for commission, to the timber purchasers as part payment for their standing timber. Quite a considerable number of sleepers is supplied in this way, usually 25 per cent. to 30 per cent. of the whole number.

(*iii*) The largest source of supply is from departmental fellings in which the timber suitable for sleepers is sawn up in mills near the felling area, or sometimes, in the case of scattered fellings, by hand-sawing in the felling area.

The sleepers supplied by the Forest Department are delivered to the Railway under a three-year contract in accordance with which the Forest Department is bound to supply a certain number in each year, under certain penalties in case of short delivery. Under the present contract 125,000 sleepers are to be supplied per annum and the Forest Department has the option of supplying 10,000 additional sleepers annually if available. The passing of the sleepers is carried out by gazetted officers of the Forest Department.

It will be seen that this arrangement differs from those in force elsewhere in that a regular contract is signed with penalties in the event of short delivery. For the past three years there has been no difficulty in supplying the full number contracted for.

BENGAL.

The sal forests in Government reserves in Bengal are not of very great extent, and they yield timber of very fine quality for which there is always a good public market. Sleeper supply is therefore of quite minor importance. But the Forest Department generally take on some small sleeper indents including a number of special size sleepers. Some of the sleepers are made departmentally and some taken over from forest lessees in part payment of their instalments of forest revenue. When the sleepers are made over to the Railway, payment is made by the usual adjustment between two Government Departments, *i.e.*, by raising and accepting debit. The price of the sleepers is then shown in the Forest accounts, either under R. I. or as lessees' instalments under R. II, as the case may be. Nothing could be simpler than this arrangement, but it might have to be altered if large orders were accepted, because sleepers can only be taken as part payment of a lessee's instalments of revenue provided that their value does not exceed the instalments due. If more sleepers than this were taken over from lessees it would become necessary to pay for them in cash, as provided for under the U. P. and Assam systems.

BEHAR AND ORISSA, THE CENTRAL PROVINCES AND THE SAL FORESTS OF THE NORTHERN CIRCARS (NORTH OF MADRAS PRESIDENCY).

Behar and Orissa, the Central Provinces and the sal forests of the *Northern Circars* (*north of Madras Presidency*) are dealt with together because they are the home of the so-called "C.P. sal" sleeper. "C.P. sal" sleepers are produced in the great forest, probably more than 50,000 square miles in area, which lies mainly in Chota Nagpur, Orissa, the Northern Circars and the east of the Central Provinces. It extends right up into Rewah State and Mirzapur district (U.P.); but some of it, especially towards its northern limits, is little better than scrub jungle. Elsewhere, many tracts of good sal forest have been temporarily worked out, but there are still considerable areas stocked with big timber.

There is scarcely any demand for "C.P. sal" except for sleepers. Roughly 70 per cent. of the outturn comes from feudatory states, of which there are about thirty, and from private forests.* In the states, the forests are generally worked under long-term leases, and on the termination of such a lease there is not, as a rule, much timber of exploitable size left. But in this part of India there is generally abundant established sal regeneration; and, as many of the forests are now being brought under careful management, they can be depended upon to yield plenty of timber again in the future.

The remaining 30 per cent. or so of the "C.P. sal" that comes on the market is produced in Government reserves: the most important of these are the Saranda, Porahat, Kolhan and Sambalpur divisions in Orissa, and Balaghat, South Raipur and Mandla in the Central Provinces.

A Calcutta firm holding long-term leases extracts most of the sleepers produced in these Government forests; but there is also an increasing number of local contractors, who take small short-term or annual leases but have not as a rule got enough capital to make them reliable sleeper contractors from the Railway's point of view.

In the C.P., the Forest Department have recently taken steps to bring a few of these small contractors into closer touch with the Railways, and the following method has been adopted experimentally on a small scale. Having marked a coupe and estimated how many sleepers it should yield, the Divisional Forest Officer announces that so many sleepers are required from it by a certain date and calls upon contractors to tender the price at which they will deliver them. The Divisional Forest Officer accepts the most favourable offer, buys the sleepers at the price so fixed and makes them over to the Railway at a price previously agreed to by the Conservator. The difference between the two prices is thus the forest royalty. The sleepers are passed by the Railways' passing officers. This system, which is being tried experimentally in the C. P. only, would be impracticable

* The outturn from private *zamindari* and *malguzari* forests probably does not amount to much as they have mostly been worked out for the time being.

for forests from which a large part of the outturn is in other than sleeper sizes.

The experience thus gained has now led the C. P. Forest Department to launch out into departmental operations for the direct supply of sleepers to Railways, and this work will be greatly facilitated by the construction of the 2 ft. gauge steam tramway from Kurud Station, on the Dhamtari branch of the B. N. Ry., into the sal forests of South Raipur division. This line, which is 60 miles long and has been built entirely for the transport of forest produce, will be opened for working on 1st December 1926. It will be a fair-weather line, as it crosses the Mahanadi river by a temporary bridge which is to be taken up each year before the break of the rains.

The Balaghat and Mandla sal forests have recently suffered from a severe epidemic attack of the sal borer beetle, the larva of which bores into the sapwood and heartwood and in several attacks kills the trees. The damage from this cause has been so extensive that the Chief Conservator of Forests thinks it may eventually be found necessary to rest the forests from sleeper operations for a considerable period.

In Behar and Orissa the Forest Department have not hitherto supplied any sleepers direct to the Railways; but they intend this year to supply some under a system which will be very similar in practice to the U. P., Bombay and Assam operations because, like them, it will allow the forest lessees to pay instalments of forest revenue in sleepers instead of in cash. Coupes are auctioned on condition that the lessees supply so many sleepers at a price previously agreed upon between the Forest Department and the Railways. Passing will be done by the Railways' passing officers, the Railway will pay the Forest Department for the passed sleepers and the lessee will then be credited with their value by deduction from the balance due by him on account of instalments of forest revenue. If the value of the passed sleepers exceeds the instalments of forest revenue due from the lessee, the excess will be paid over to him in cash. The success of this system will partly depend on prompt passing

and payment by the Railways; this is not likely to present any difficulty because the Eastern Sleeper Group have a very well organized Sleeper Control and Sleeper Passing establishment.

PUNJAB.

The Punjab timber market (in which the railways' demand for sleepers plays a very important part) is mainly supplied from the forests of Kashmir, the Punjab and several Hill States. Of these sources of supply Kashmir is by far the most important.

The deodar reserves in the Punjab are all worked semi-departmentally, that is to say the Forest Department employ contractors to fell, convert and extract the timber and then the Forest Department sell it in the shape of sleepers, or in other sizes. The Forest Department in this way make about one lakh of deodar sleepers a year and sell them to timber merchants, who in turn sell them to the Railways, making a profit on the deal.

Direct supply by the Forest Department to the Railways has recently been under consideration and will, it is hoped, be introduced before long.

The employment of intermediaries between a State Railway and a State Forest Department which exploits its forests departmentally seems on the face of it absurd; but although it is an obviously unsatisfactory arrangement it is not wholly without reason. As Government departments do not usually make formal contracts with one another, supported by penalty clauses it follows, generally speaking, that if one of them fails to complete its part of an agreement the only redress it can offer is a perfectly useless letter of regret.

It may be said that this objection could only apply to dealings with State Railways. This is quite true: the Bombay Forest Department have in fact got a regular contract, with penalty clauses, with a Company Railway. But in some provinces it would very likely be difficult to obtain the Local Government's sanction to such a contract. And without such a contract it may be admitted that a Chief Engineer's reluctance to launch out into direct dealings on a large scale with the Forest Department is intelligible. This is a difficulty that will probably

have to be faced in some provinces, especially if the Forest Department wish to do business with Railways or other large purchasers who have had no previous experience of direct supply by Forest Officers.

MADRAS PRESIDENCY.

In Madras the Forest Department has overcome the difficulty just mentioned by a method which has much to recommend it for provinces or states where departmental extraction of sleepers and direct supply to the railways are in their infancy, because it obviates the necessity of making an accurate estimate of outturn.

At present the chief sources of sleeper supply in the south of India are private forests in Malabar and adjoining districts, which are worked by permit-holders or lessees. As pointed out in the report of the Sleeper Enquiry Committee, the sleeper market in South India is an unsatisfactory one. The one really good sleeper wood is teak, but it is only converted into sleepers in limited quantities. *Irul (Xylia xylocarpa), nangal (Mesua ferrea), irumbogam (Hopea parviflora) and karumarudu (Terminalia tomentosa)* are the standard hardwood sleepers; and the fact that *Terminalia tomentosa*, although the most widely distributed of all, is not accepted as a sleeper wood in any other part of the country indicates the comparatively poor quality of the South Indian sleeper woods generally. For this reason the development of sleeper-treating is perhaps of more urgent importance in South India than elsewhere.

The Government reserves, being generally more remote from the railways and in difficult country, are not worked by lessees as a rule and until recently produced hardly any sleepers (some teak excepted). But they are now being opened up by departmental operations on a considerable scale. As the growing stock in almost all South Indian forests is very mixed only part of the outturn consists of the standard sleeper woods. Consequently the number of sleepers extracted has not reached a large figure yet, and it is difficult for the Forest Officers to estimate beforehand how many will be extracted during a working season.

The Forest Department and the Southern Sleeper Group have, therefore, come to an agreement by which the Chief Engi-

neer accepts all the sleepers the Forest Department can deliver but sets them against his demand for the year after they are delivered. Thus, if actual deliveries are less than expected, he still has ample time to arrange for the balance of his requirements by purchase in the open market. It follows that the Forest Department do not receive payment for the sleepers till the year after that in which they are supplied. Against this slight disadvantage, if it can be called a disadvantage, must be set the facts that the Forest Department are free to make as many sleepers as they can with the knowledge that all will be accepted at the agreed price and that they will suffer no penalties (and the railways no inconvenience) if the quantity they supply turns out to be small. The Railways accept the Forest Department's passing.

It will be seen from what has been written that some progress has been made in nearly every province towards direct dealings between the two departments. It has been said that their interests must be antagonistic because each is intent on improving its own revenues. This is only true to the extent that the Railways would doubtless be glad if the Forest Department would sell them all the sleepers they require at much below their real value, while the Forest Department would be equally delighted if the Railways would buy all the sleepers it wants to sell at a price much in excess of their value. But as neither department expects the other to adopt such an altruistic policy, we may say that for all practical purposes their interests are very closely allied. For in many provinces the Railways' sleeper requirements are a very important factor in the general demand for timber, and could become still more important if sleeper-treating were developed in India; obviously, therefore, it would be against the interests of the Forest Department if the Railways were to be driven by high prices of wooden sleepers to convert their wooden sleeper tracks to tracks laid with metal sleepers.

That the two departments did not begin to co-operate years ago is doubtless due to the facts that wooden sleepers were plentiful and cheap then, that private forests were being

cut down wholesale and that the Forest Department was much more intent on protecting and preserving its forests than on selling their produce. Such attempts as were made to market timber departmentally were sometimes carried out in haphazard fashion, and probably did us more harm than good. Mr. Smythies has referred in his article to criticisms passed on the Forest Department as supplier of timber to Railways. Such criticisms are the result of unsatisfactory dealings and lack of co-ordination in the *past, and they generally amount to a complaint that we are "unbusinesslike" to deal with. The criticism does not only come from the Railways; and it is no doubt often made by ill-informed persons who suppose that a Forest Officer's only duty is to sell timber, and that it is impossible for anyone to do anything efficiently unless by blindly copying the methods adopted by business men in commerce. That type of critic forgets, or more probably does not know, that Forest departments are brought into existence because Governments find it necessary to protect their forests from destruction by business men. But if Chief Engineers of Railways say that the Forest Department is "unbusinesslike," what they usually mean is that they do not feel we can be depended upon to fulfil the contracts we undertake. In this matter of fulfilling undertakings it is impossible for the Forest Department to over-estimate the importance of being "businesslike;" for, from a Chief Engineer's point of view, the supplier who offers 10,000 sleepers by a certain date and delivers them all by that date is a much better and more "businesslike" man to deal with than one who offers 50,000, but, having only delivered 30,000 within the agreed time, proposes to supply the balance in the following year. It is just as well, therefore, that direct dealings

*In those days the prices paid for sleepers by the Railways and the royalties realised by the Forest Department were supposed to be dead secrets: *cf.* page 68 of Vol. II, Part II of Indian Forest Memoirs (published 1913) where it is stated that the prices paid for sal sleepers cannot be stated as the Railways wished them to be treated as confidential. To-day prices and royalties can be frankly discussed between Forest and Railway Officers; and they were published in 1924 in the Report of the Sleeper Enquiry Committee, which can be bought by any one for Re. 1-12.

between the two departments should not be pushed on very rapidly; there is always the risk of a set-back if such undertakings are begun on too ambitious a scale, whereas steady development from small beginnings is easy.

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SPECIAL GROWTH OF TREES.

An interesting short article on the spiral growth of trees by Mr. Alexander L. Howard appeared recently in "The Timber Trades Journal." Attention was particularly drawn to this defect during the war owing to its prevalence in *Picea sitchensis*, the timber of which was being tried for air-craft construction. Articles published in America are quoted which discuss the possibility of twisted growth being an inheritable feature and the desirability of study to test this hereditary tendency theory. Wind is in these considered likely to have an influence on spiral development. The conclusion is quoted that twisted fibre in some instances at least is unquestionably capable of being transmitted from one tree generation to the next and it is questioned whether there is not therein a suggestion for those who would propagate figured mahogany and other fancy cabinet woods.

Mr. Howard ably explains the difference between the valuable feature of figure in timber and the defect of spiral grain. He also opens up the subject of the cause of figure. He considers figure to be caused by continually repeated and greater or less rapid changes in the formation of the growth of the grain and suggests that the effect or value of rays of light or the suns rays may be the most important factor controlling the whole manner of the growth of the trunk of a tree. Trees in swampy land are said to be invariably straight grown without any figure, while those on elevated, irregular or rocky ground with a varying supply of moisture are found to contain figure more or less strongly marked.

As regards twist Mr. Howard says that much more enquiry is required before the hereditary theory can be accepted. He emphasises rather the influence of wind. "The currents of wind must undoubtedly be the most important factor, but it must be the effect of several different influences taken together which produces the spiral growth." The defect is quoted as common in many trees around Darjeeling and in the cypress trees near Numara Eliyia in Ceylon. He concludes that instead of directing attention to the seed and heredity more care should be displayed in regard to guards, nurses and plantations.

The article, however, fails to bring to notice the valuable work that has already been done in the study of this subject of twisted fibre. The prevalence of twisted fibre in *chir* (*Pinus longifolia*) in the Kumaon Forests has for over 15 years been the subject of constant observation by Forest Officers. Its importance has been fully appreciated and experimental work has been put in hand. In the *Indian Forest* Records, Volume XI, Part II, published in 1925, *Champion* gives some "Contributions towards a Knowledge of Twisted Fibre in Trees." The Bibliography quoted comprises a list of 53 references and a large number of excellent photographic illustrations are given mainly of twist in *chir* (*Pinus longifolia*)

In Part I the phenomenon of twisted fibre with special reference to *Pinus longifolia* Roxb. is considered.

The various sections deal with the description of the phenomenon, its relation to the locality, commercial significance (the question of inheritance and the possible causes of its origin)

In the conclusion it is suggested that unidirectional spiral movement of the protoplasm in an elongated growing cell may give a unidirectional spiral structure to the cell wall resulting in a tendency to unidirectional axial inclination in a cell, liable to be emphasised by sliding growth. The article must be read in full to be properly appreciated but heredity is in a guarded manner suggested to be a feature of twisted fibre. Experiments have so far in the case of *chir* failed to substantiate

the theory of injury during youth, which was formerly held by many forest officers to be an important factor in initiating twist. The experiments, however, require to be continued over a longer period of years than has hitherto been possible.

At present experiments are under investigation for *chir* in regard to—

(*i*) The effect on the course of the fibres of restricting the circulation by girdling or banding.

(*ii*) The effect of damage on straight fibred plants.

(*iii*) The later development of coppice shoots from straight and twisted stocks.

(*iv*) The details of changes with age in twisted plants.

Part II gives details of the investigation on the possible inheritance of twisted fibre in *Pinus longifolia*, Roxb. The various sections deal with the evidence of inheritance in existing crops, previous work on the inheritance of parental factors, the factors involved in the experiments, such as origin of seed, localities of areas sown, examination of the seedlings, statistics of the investigation and concerning inheritance and deductions from the same and theoretical considerations.

The investigation included the detailed examination of a total of over 6,000 seedlings and coppice shoots from one to six years old

The conclusions arrived at are—

(*i*) It is a character common to all trees to produce a varying but small proportion of individuals with twisted fibre the twist being L at first but changing to R with passage of a period of time varying greatly in length with the species.

(*ii*) There is probably a certain amount of fluctuating variation in the direction of the fibre accounting for occasional exceptions to this general rule, others being perhaps traceable to special inhibitive influences.

(*iii*) In areas where twist is exceptionally frequent, twisted fibre, or a tendency to produce it, is unquestionably capable of being transmitted from one tree generation to the next.

(*iv*) Conditions found in existing forests make the inheritance of twist as an acquired character difficult to accept as a satisfactory explanation.

(*v*) In such areas, a twisted variety may have originated possibly by a simple loss mutation of a factor controlling the orientation of the growing cells. Such mutation must have originated independently in many localities, its survival being favoured by the continued selection of the straighter trees for remova .

(*vi*) Sound forest management on the generally accepted lines, especially as regards seed-selection and thinning, should result in time in the elimination of twisted trees.

F. C

[We have much pleasure in publishing in this number a further article by Champion on twisted fibre in *Pinus longifolia* from which it is quite evident that the tendency to twist is an inherited character apart from any influence which may be due to environment.—ED.]

AN INTERIM REPORT ON THE PROGRESS OF INVESTIGATIONS INTO THE ORIGIN OF TWISTED FIBRE IN PINUS LONGIFOLIA ROXB.

In Indian Forest Records, Vol. XI, Part II, 1925, I gave an account of the results obtained from observation and experiment on the problem of twisted fibre, up to my last inspection (September 1923) of the four experimental areas in the West Almora division of the Kumaon Circle, United Provinces. Since that date the areas have been well looked after by the divisional staff, and an inspection in the first week of October this year has

yielded a certain amount of information which seems worth publishing now, since the Record is not likely to be revised for several years at least.

At *Ranikhet* (Kaligadh) the sowings have suffered numerous casualties which were at first suspected to be due to the fungus *Peridermium* but which were subsequently realised to be chiefly ascribable to the girdling attacks of a small *Lepidopterous* larva. Three lots of seed of different origin were sown here, A from Nandhaur range, Haldwani division, where the crop is 100 per cent straight fibred, B from 100 per cent twisted crops near Ranikhet, and C from the local tree (selected as straight fibred) which form a crop 95 per cent straight fibred. Only a few of the injured plants were uprooted and examined, 5, 6 and 5 from A, B and C respectively, all with woody stems 0·5"—0·7" diameter under bark near the base, and six seasons old. Of these, all from A and C, were quite straight fibred throughout, but of the 6 from B, three were strongly twisted (over 15°) throughout, the other three being nearly or quite straight.

At *Maharpali*, recovery from the fire of 1921 has been remarkable, and the closing up of the crop now ten seasons old permitted of the removal of a fair number of plants from all plots. These plants have all been examined as in previous years*, except that the roots were not dug up.

The following table summarises results from these plants :—

Plot	Origin of seed	Number examined.	Average Factorial Twist.	Percentage in each twist class.			
				s	½	t	2t.
G	Naini Tal 100% straight crop	49	0·25	92	8	..	...
A	Khabdoli 90% straight crop Straight trees	40	1·15	73	22	5	.
B	Khabdoli 90% straight crop Twisted trees	24	4·17	16	42	42	..
C	Maharpali 98% twisted crop Straight trees	10	3·20	30	40	30	..
F	Maharpali 98% twisted crop Twisted trees	41	6·15	10	21	58	10
D	Maharpali 100% twisted crop Natural Regeneration	37	4·16	22	24	49	5

* Twist grades are as follows :—

s = 0°—5° ; ½ = 5°—15° ; t = 15°—25°, 2t = 25° and over. Numerical values assigned to s, ½, t and 2t are 0, 2, 4 and 8 respectively.

NOTE.—*Average Factorial Twist* is calculated from the twist grades of the basal (three diameters) and lower stem (next ten diameters) sections.

Percentages in the several twist classes are based on the highest grade found in *any* part of the stem except the basal.

The plants in D are four years older than the rest.

In this work, it has been accepted that a minimum of 100 stems should be examined in every case, so that too detailed a comparison of these figures may lead to unwarranted conclusions; their general trend is however perfectly clear and supports strongly the already recorded conclusion, *viz.*, that *whatever additional factors may come into play, the tendency to develop twisted fibre is inherited through the seed.*

Plates 1 and 2 show typical twisted stems from sowings of seed from a 100 per cent twisted crop. A single spiral has been marked on each showing 6 or 7 complete turns. In plate 1 are stems which have not been coppiced and plate 2 shows coppice shoots.

It is interesting to compare these results with ten year old plants with those from younger plants from the same sowings—average factorial twist being the simplest and clearest method of expression though slight differences are caused through the different size of the seedlings

Plot.	G	A	B	C	F	D
1918—2 seasons old ...	1·2	1·88	2·95	3·21	3·88	?
1921 $4\frac{3}{4}$,,	0·75	0·97	2·50	1·80	2·91	?
1923—7 ,,	?	0·7	?	?	4·1	?
1926—10 ,, ,,	0·25	1·15	4·17	3·20	6·15	4·16
Mean	0·57	1·17	3·21	2·74	4·26	4·16

It will be noted that although the relative magnitude of these figures varies appreciably in the several years the order is constant

Typical twisted stems which have not been coppiced.
10 season old *Pinus longifolia* from sowings from twisted crops at Maharpali, West Almora Division, Kumaon. One spiral marked.

Fig. 2.—Coppice shoots of 1921 (6 years old).

Fig. 3.—Stems showing spiral contortion resulting after snow pressure.

with hardly an exception as shown in the following table in which the factor is replaced by the number representing the position of the plot in order of increasing twist.

Age in years.	G	A	B	C	F
2	1	2	3	4	5
4½	1	2	4	3	5
10	1	2	4	3	5
Mean	1	2	4	3	5
Parent Crop	1	2	(3)	(4)	5

It may appear curious that B originating from isolated twisted trees in a predominantly straight crop, should persistently show more twist than C derived from isolated straight trees in a predominantly twisted crop, but if twist is ultimately connected with a dominant Mendelian character, something of the sort would be expected; in any case the values of both B and C consistently fall between those of the straight crops (A and G) and the twisted (F).

The 1926 figure for the natural regeneration of D is unexpectedly lower than that for F, sowings of seed from almost the same parents, but deductions are unsafe partly from the relatively small number of plants examined and partly because there was a considerable element of selection in the stems removed. Its agreement with the mean figure for F (4·26) may be noted. The only earlier figure available for D is the original one of 1917 when with an average age of 3½ years, the average factorial twist was about 2·5.

The late heavy snowfalls of 1923 did a lot of damage in Maharpali, bending over many plants which have subsequently more or less straightened out. The remarkable cork-screw appearance of some of the twisted fibred stems so affected is noteworthy, no straight fibred stem having become thus spirally contorted (Plate 3).

In *Khabdoli* the plants were so thinned out by the 1921 fire, that no more could be removed for examination. The same remark applies to *Sarna.*

In two localities near Ranikhet experiments were started in 1921 to study the effect on the course of the fibre in the wood subsequently formed of partial girdling, and of binding tightly with wire. It was found that in only a few cases had the diameter increment of the poles selected been sufficient to be likely to give clear indications, so it was decided to wait another 2 or 3 years before felling for detailed examination.

Conclusion.—Sowings of seed of known parentage have demonstrated clearly that spirally twisted fibre in *Pinus longifolia* in Kumaon is inherited from the parents. Seedlings of all ages up to ten seasons (excluding one season old plants) exhibit a percentage of twisted stems and a degree of twist proportional to that of the parent crop from which they are derived. This result is obtained with protection from all the ordinary forms of damage showing that the latter cannot be the immediate cause of twist and, it has also been shown that coppicing once or twice by fire or other means does not appreciably alter the proportions of straight and twisted plants.

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THE FRENCH METHOD OF 1883 AND ITS MODIFICATIONS.

In his letter published in September number of the *Indian Forester* Mr. Smythies has referred to another modification of the French Method which has been effected by Mr. Beylea* of the New York State College of Forestry Without entering into a detailed discussion of this new modification, it may be stated generally that it is of little practical value, since Mr Beylea's procedure involves the presupposition of normality of a given forest whose annual cut is to be determined The question which generally arises is whether a forest is normal or not, and the special feature of the French Method is that it provides us with a ratio to ascertain the normality of a given forest. It is precisely

*Footnote by Mr. Smythies —This was not the gentleman referred to in my letter.

E A. S.

this important thing that Mr. Beylea has lost sight of in trying to modify the French Method. He supposes the normality of a given forest instead of determining it, and thus begs the very question he seeks to answer. This is not all, Mr. Beylea's formula for the calculation of the yield is theoretically unsound, not to mention other errors which he has introduced in his attempt to modify the French Method.

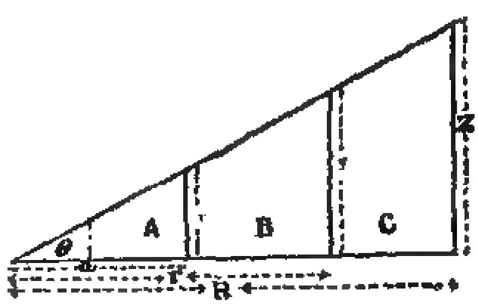
Mr. Smythies' modification, on the other hand, is mathematically correct and unlike the American modification, is of real scientific value. Its only drawback, however consists in the difficulty it presents in the conversion of the standard 4-inch class enumerations into diameter groups which represent the average and the old wood. Graphical interpolations, involving as they do, considerable errors particularly in selection forests where the distribution of diameter classes is abnormal are available for the derivation of the number of trees equally for the French as well as the modified groups from 4-inch diameter class enumerations. It will then be difficult to claim any practical advantage for the modified groups over the old method of French grouping. It only remains to add that this modification involves more mathematical calculations than the French Method and it is therefore not likely to be popular unless a distinct practical advantage can be secured.

Having pointed out the modifications of the French Method proposed hitherto, I may here take the opportunity of proposing another modification which, I venture to believe, would meet all objections. In the normal forest triangle the relation between

the young wood (A

the average wood (B)

and the old wood (C)



is given by the relation :

$$A \quad : \quad B \quad : \quad C$$

$$\text{or} \quad ax \quad : \quad ry - ax \quad : \quad RZ - ry$$

$$\text{and since } \tan\theta = \frac{x}{a} = \frac{y}{r} = \frac{Z}{R}$$

we have, by substituting x and y in terms a, r R and Z

$$A \quad : \quad B \quad : \quad C$$

$$\text{as} \quad a^2 \quad : r^2 - a^2 : \quad R^2 - r^2$$

It is obvious that if this relation exists in a forest it would be normal whatever be the value of a and r. Thus, it is possible to carry out enumerations to whatever diameter limit it is deemed profitable. The age corresponding to this diameter would be a The value of r may be made to correspond with any age to retain the 4-inch class enumerations. A hypothetical example will serve to illustrate the procedure

Species	... x
Rotation (R)	... 150 years.
Lowest enumeration limit ...	... 8 inches.
Diameter corresponding to rotation	... 24 inches.
Age corresponding to 8 inches (a)	... 40 years.

Omitting the growing stock under 8 inches, the remaining crop may be enumerated in the conventional diameter classes According to the Indian practice, which involves enumerations in 4-inch diameter classes, the volume of the remaining growing stock would be distributed in the following manner :—

Diameter class	Volume.
8 — 12 inches ...	... V_1 cubic feet.
12 — 16 "	... V_2 " "
16 — 20 "	... V_3 " "
20 — 24 "	... V_4 " "

The position or r can now be fixed anywhere to coincide with one of the 4-inch diameter classes Let "r" be the age corresponding to diameter 16 inches (it can equally well be the age corresponding to 12 or 20 inches) and let it be 90 years. The normal proportions now between the average wood V_1 + V_2 and

the old wood $V_3 + V_4$ can now be determined by substituting the values of a, r and R in the general formula thus,

$$
\begin{array}{lllllll}
 & a^2 & : & r^2 - a^2 & : & R^2 - r^2 \\
\text{or} & 40^2 & : & 90^2 - 40^2 & : & 150^2 - 90^2 \\
\text{or} & 16 & : & 65 & : & 144
\end{array}
$$

Omitting the young wood from consideration the rest of the growing stock is normal as long as the ratio between the average $(V_1 + V_2)$ and the old wood $(V_3 + V_4)$ is 65 : 144 If the actual proportions are different then necessary adjustments can be made as is done in the old French Method The annual cut now will be given by the formula,

$$\frac{V_3 + V_4}{R - r} + \frac{\text{Annual increment of } V_3 + V_4}{2}$$

While removing most of the objections usually raised against the French Method, the above suggestion renders it possible to retain the normality check which is the important feature of the French Method. It will be seen that it is also possible to choose any limit upto which trees should be tallied which, if need be, may coincide with the merchantable diameter. The position of r can be so fixed as to retain the conventional diameter classes in which the enumerations are to take place and the material is to be sold.

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DURABILITY TESTS OF MALAYAN AND OTHER TIMBERS.

The Forest Department of the Federated Malay States started, in 1918, a series of tests to determine the resistance of the different woods to the attacks of insects and of decay. These tests have been extended, from year to year, and have included a total of more than 5,000 pieces of wood.

The place chosen for the tests was a well shaded, moist, and fairly well-drained spot in the Weld Hill Forest Reserve, Kua a

Lumpur, on the lower part of a hill slope. The soil is a mixture of clay, gravel, and laterite and is rather stiff. There is uniformly high humidity. Trenches were dug to a depth of 15—18 inches. The pieces of wood were placed in the trenches with a slight uphill stand, and projecting about six inches above the surface of the ground. The trenches were filled up and the earth tramped down firmly.

The pieces of wood are two feet long and two inches square. Sound and seasoned material has been used whenever it was available, but it has often been necessary to use wood which was only partly seasoned.

The pieces have been dug up and examined at intervals of six months. More than one hundred kinds of local woods have been included in the tests of untreated material. A large series of tests has been started with material treated with various preservatives. Various woods from other countries have also been added. These include billian from Sumatra, greenheart from British Guiana, teak and kiam from Siam, sal from Bengal, and a number of woods from Burma. Mr. E. O Shebbeare, now Conservator of Forests, Bengal, helped us to obtain good material of sal, and Mr. J. C. Hopwood, then Conservator for Utilization, Burma, helped us to obtain good material of certain Burmese woods. These woods have now completed five years in the testing ground and it seems a good time to compare their behaviour with that of some of the more durable Malayan woods which have been tested for a similar period.

The following tables show the condition of the pieces at the end of each year. The symbol "S" indicates that the piece is perfectly sound and shows no sign of damage, "A" that it is attacked, "B A" that it is badly attacked, *i.e.*, it shows signs of damage on all sides or has been deeply penetrated, and "D" means destroyed, the piece being so badly attacked as to be no longer useful.

EXOTIC WOODS—

Wood.	Original No. pieces	1 YEAR				2 YEARS.			
		S	A	BA	D	S	A	BA	D
Billian—*Eusideroxylon zwageri* ..	6	6		..	...	6	...	...	..
Green cart—*Notandra sp.* ..	3	3	..	..	..	3		...	...
Ingyin—*Pentacme siamensis* ..	6	6		...	...	3	3	..	
Teak—*Tectona grandis* ..	6	6	..	...		2	2	..	..
Thingan—*Hopea odorata* ..	6	6	...	..	..	6	..	..	..
Taukkyan—*Terminalia tomentosa.*	6	6	..	...	..	5	1	...	..
Pyinkadu—*Xylia dolabriformis.*	6	6	...	..	..	4	2	...	...
Kanazo—*Heritiera minor* ..	6	3	3	...	..	3	2	1	..
Thitya—*Shorea obtusa* ...	6	1	5	...	...	1	3	..	2
Sal—*Shorea robusta* ..	12	...	8	4		..	7	3	2
Kaunghmu—*Parashorea stellata*	6	..	3	1	2	..	1	2	1
Kiam—*Cotylelobium sp.* ..	5	..	4	1		..	1	4	..

A second lot of teak was started in 1923. There were 14 pieces in the lot. At the

5 YEARS TEST.

3 YEARS.				4 YEARS				5 YEARS				Pieces destroyed in 5 years.	REMARKS
S	A	BA	D	S	A	BA	D	S	A	BA	D		
4	.	.		4			..	3	1	..	.	...	2 removed in 1922
3			.	2	1			2	1				
3	3		..	3	1	2		1	2	3	..	...	
2	2	.	..	2	1	1			3	1	..	.	2 removed in 1922
3	3	..	..		5		1		5		.	1	
5	1	..	..	5	1		..		3	2	1	1	
4	2	..			6			.	1	5	.		
2	1	2	1	2		2	1	.	1	2	1	3	
1	2	..	1	1	1	1	.	..	...	3	..	3	
...	...	9	1	...	.	4	5	...	..	2	2	10	
...	.	2	1	..		1	1	.	...	..	1	6	
...	...	3	...		..	2	1	...		1	1	2	2 removed in 1922.

end of three years 1 piece s attacked and 13 are badly attacked

MALAYAN WOODS—

Wood	Original No. pieces	1 YEAR				2 YEARS.			
		S	A	BA	D	S	A	BA	D
Giam—*Hopea nutans* ..	11	9	2	...	..	8	3	...	.
Chengal—*Balanocarpus Heimii*	25	7	18	...	.	5	7	1	.
Resak—*Shorea spp.* ..	89	59	26	.		21	46	12	6
Resak—*Vatica sp.* .	15	0	5		...	1	6	2	4
Sengkawang—*Isoptera borneensis*	9	4	5		..	4	3	1	1
Tempinis—*Sloetia sideroxylon* ..	6	4	2	...	.	4	2	...	...
Tembusu—*Fagraea gigantea*	9	3	6	..	.	2	4	..	3
Merbau—*Intsia sp.* ...	7	7		..	.	4	2	1	.
Betis—*Payena utilis* .	7	6	1	.	..	5	2	...	...
Penaga—*Mesua ferrea* .	6	6	.		.	6	..	...	..
Bungor—*Lagerstroemia Flos-Reginae.*	12	4	8			4	7	1	
Leban—*Vitex pubescens* ...	8	8		..	..	8	.	..	...
Dedali—*Strombosia javanica* ..	12	4	8		...	.	9	..	3
Meranti pahang—*Shorea sp.*	6	..	6		.	.	4	..	..
Petaling—*Ochanostachya amentacea*	5	5	.	.	.		5	..	.
Dungun—*Heritiera littoralis* ...	4	.	4		...	.	3	..	1

5 YEARS TEST

3 YEARS.				4 YEARS				5 YEARS				Pieces destroyed in 5 years.	REMARKS
S	A	BA	D	S	A	BA	D	S	A	BA	D		
6	3	2	.	6	2	3		3	2	4	.		2 pieces removed in 1922.
5	11	1	6	5	1	11		4	2	11	..	6	2 pieces removed in 1922.
19	45	6	1	18	34	12	2	11	35	16	3	12	15 pieces removed in 1932,
.	3	3	2	...	4	2	.		4	2	.	6	3 pieces removed in 1922.
4	1	2	..	4		3	.	...	4	3		1	1 piece removed in 1922.
2	1		.	2	1		..	2	1	...	...	...	3 pieces removed in 1922.
2	4	..	...	2	2		.	2	2	.	..	3	2 pieces removed in 1922
1	5	1	..	1	3	...	.	1	3	..	.		3 pieces removed in 1922,
2	1	...	..	2	1			2	1	..			4 pieces removed in 1922,
.	6	.	...	...	4	...	.	...	4	.	.	.	2 pieces removed in 1922
4	7		1	3	2	2	..	..	3	3	1	2	4 pieces removed in 1922,
4	4	...	...	...	6	...	.	...	6	...	.	...	2 pieces removed in 1922
.	7	2	...	...	3	2	..	..	1	3	1	4	4 pieces removed in 1922
	4			.	4	...	...	...	3	1		.	2 pieces removed in 1922
...	5	.	...	.	5	...		...	4	1	...	..	
...	1	1	...	...	1	1	..	...	..	1	1	2	1 removed in 1922

Notes.—Pieces removed in 1922. Quite a number of pieces were taken from the testing grounds for display at the Malaya Borneo Exhibition at Singapore in March-April 1922. These pieces were not returned to the testing grounds.

Meranti pahang is included because it is the local wood which is most like sal.

It has been found that "white ants," or termites, are the chief cause of damage. They are so plentiful and so active that very few woods perish from decay. Many of the less durable woods may be destroyed in six months or a year. It often happens that the portion of the wood above ground is still sound when the underground portion has been badly attacked or destroyed.

Termites prefer to work in the dark. The conditions are so severe in our testing grounds that any wood may be considered very durable if it lasts five years.

Some general remarks are suggested as a result of these tests :—

1. Billian, greenheart and *ingyin* proved to be the most durable of the foreign, and *giam*, *resak*, *chengal*, *tempinis*, *tembusu*, *merbau*, and *betis* of the local woods.

2. It is obviously incorrect to speak of any of these woods as immune to white ant attack.

3. It seems that a wood which is regarded as very durable in one country may not prove to be so in another country and climate. Thus teak, which is in many places highly regarded, has proved to be distinctly subject to white ant attack in this country.

The pieces of teak included in the tests were selected with special care and seemed to be the very best quality obtainable. There have been a number of cases reported to us, by architects and builders in Singapore, where teak has had to be removed from buildings within a short time after construction, because it was so badly attacked by white ants. It is quite probable that our white ants are local species and it is quite conceivable that

some of our local woods may have developed a certain amount of resistance to their attacks.

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Federated Malay States.

THE PHYSIOGRAPHY OF SOUTHERN NIGERIA AND ITS EFFECT ON THE FOREST FLORA OF THE COUNTRY.

BY J. R. AINSLIE, B SC. OXON, SENIOR CONSERVATOR OF FORESTS, NIGERIA.—(OXFORD FORESTRY MEMOIRS, NO. 5, 1926.)

(Published at the Clarendon Press, Oxford, 1926. Price 4/-).

The author introduces his subject by stating that in countries where the physical features are well marked the relationship between the physiography and the forest distribution are most obvious. In Nigeria the physical features are small and not outstanding "but in spite of this it is surprising to find to what an extent their effects are felt on the forest vegetation." As it is subsequently shown that in a country of 80,000 square miles, greatest length 480 miles, greatest breadth just under 200

miles, the average rainfall (Appendix I) varies from 122 to 46 inches, it does not seem so very surprising after all.

The country is described as a vast sloping plain rising very gradually from the coast to an average height of 1,200 feet with occasional higher hills and mountains of 4 000 to 6,000 feet in the east.

The air currents are compared to the monsoons in India In the summer months highly moisture laden south-west winds blow directly in from the sea. In the Delta districts these winds strike a heavily forested coast and the result is a heavy deposition. Further east the forest-clad ranges and later the high table lands again cause heavy deposition. Elsewhere the rise in elevation is so gradual that it has little effect on the rainfall which decreases from 100 inches finally to 30 inches per annum. The chief factor that affects forest growth is therefore the rainfall.

The main regions have been sub-divided as follows :—

(1) The Littoral Region, (2, The Plains, (3) The Uplands

The forests are classified as follows :—(1) Littoral forests, (2) Tropical evergreen forests, (3) Tropical deciduous forests, (4) Savannah forests with two or more sub-classes in each type.

Each type of forest is described in some detail and the chief species met with in each are mentioned. The "Rain Forests," a sub-class of the Tropical evergreen forests, form most of the forest belt of Nigeria, although they have been largely encroached upon by shifting cultivation Repeated clearings favour a xerophytic type of regrowth of a very inferior nature. This is attributed to the probability that "these climatic forests originated here when the climate was more moist and when the coast line was farther north than it is now, and they are now very near their dry climatic limit."

The Memoir is well illustrated with sketch maps and photographs and concludes with appendices giving the average rainfall and a table showing the occurrence and distribution of the commoner species.

EXTRACTS.

FORESTS AND AGRICULTURE.

A Bill has recently been introduced into the Council of State by a private member to consolidate the law relating to Indian forests ; and the bearing of forests on agriculture is one of the subjects to be enquired into by the Royal Commission on Agriculture The occasion is, therefore, opportune for an examination of the question as to what exactly are the relations that ought to subsist between the Department of Agriculture on the one hand and the Forest Department on the other, and whether it is wise, as is contemplated in the Bill, and practised in many a province, to entrust the management of ryots' forests to forest panchayats.

About one thing, nobody has any doubt namely, that Indian agriculture depends for its success on the materials available from the forests. The Indian peasant requires for shelter building materials and thorn for fencing : for his cattle he wants grass and grazing ; he wants small timber for his implements, firewood for cooking, leaves for green-manuring his fields, and so on. If he does not get fuel from the forests, he uses stable refuse for the purpose and wastes that most valuable manure which, if used in his fields, would have considerably increased the crop yield. It is useless to expect him to grow fodder on his own lands, not only because of the very limited extent of land that he possesses, but also because he can utilise the lands for the purpose of raising infinitely more paying crops. Until a few years ago, what he used to do was to encroach on the reserve forests stealthily which he could not do legitimately. The result was unfortunate. The Forest Department prosecuted him and a hue and cry was raised that the ryot was being persecuted by the Forest Department. This conflict became so acute that in one province at any rate, in Madras, the forests were divided into two classes, and the less valuable ones from the state point of view were classed as ryots' forests and their management

handed over, first, to the Revenue Department, and subsequently to the panchayats formed by the ryots' representatives. This course has doubtless eliminated friction between ryots and forest officials. It has also, it must be admitted, made the ryots realise that *forest wealth cannot, without serious detriment to the prosperity of the country, be wasted.* It is doubtful, however, if the panchayats are making the best use of the forests.

Forestry, it must be recognised, is not a subject which can be practised by amateurs without doing harm to the country on any large scale. Let us consider what an efficient forest management can effect *The only solution of the fodder problem lies in* grazing reserves. Fodder, which is better than spear grass, should be grown. *It is not clear why such crops like elephant* grass should not be raised by irrigating the reserves. The ryots cannot do these efficiently. Their organisation to undertake such a task is nil. The Forest Department, which is an expert department, ought to be able to form such reserves, raise good grazing, fodder, hay and silage to be sold to the ryots in hot weather at reasonable prices when no fodder will be available for them. Nor is the fodder problem the only one in which the Forest Department can help the ryot It may be—indeed, it is the case in several places, that the ryot has learnt to grow his own green dressings for manure But the difficulty with many at present is to get a sufficient quantity of seed for raising these dressings. Plants like *kolinji*, wild indigo, and *dhaincha* may be easily raised and grown by the Forest Department on a large scale and their seed harvested and made available to the ryot through the Agricultural Department. Another direction in which the Forest Department might help the ryot is by providing him with synthetic farmyard manure. The experiments conducted by the Department of Agriculture, in Madras, on the lines laid down at Rothamstead have shown that it is easy to make farmyard manure in pits from refuse material by simple methods. There is a large supply of such materials as lantana, coarse grass, undergrowth, etc., available in forest reserves The Forest Department *might manufacture* such manure as a cheap substitute for bulky organic nitrogenous manures.

In the three directions mentioned above, the Forest Department might help the agriculturists. Agricultural expert opinion is inclined to the view, despite the tolerable success in a sense of the forest panchayats, that the ryots' reserves would be best entrusted to the Forest Department at any rate for some more years that is to say till the ryots are taught the most economic methods of forest exploitation to come. The ryots may be managing these reserves to the best of their abilities but they are not well versed in the science and up-to-date practice of forestry. If they were they would have utilised every inch of available ground which is not now under cultivation for the planting of trees. The farmers of Canada and the United States have grown woodlots and windbelts in the prairie provinces with very beneficial results from every point of view. The Department of Forests as well as the Department of Agriculture there co-operate and are conducting with considerable success a sustained propaganda for the planting of trees. In India also, this ought to be possible There is a large extent of waste land available in the country and every endeavour should be made to raise at least trees on them. This cannot be done without the aid of technical assistance from the Department of Forests and the Agricultural Department. The ryots should be shown the value of such work by "demonstration' forests maintained by the Forest Department. It is no use surrendering the forests to their management.—[*Capital.*]

AUCTION SALE OF INDIA AND BURMA TIMBERS.

An important sale of Indian timbers by order of the Governments of India and Burma was held on Wednesday last in the Small Hall at Winchester House, by W W. Howard Bros & Co. in conjunction with Joseph Hibbard & Sons. A representative company assembled consisting of London and provincial hardwood merchants, and for the pyinkado, laurel, and round Burma logs competition was keen.

Mr. Hibbard, in opening the sale, which commenced at 2 P.M., called upon Mr Alex. L. Howard to introduce the

timbers lotted in the catalogue. Mr. Howard said that these timbers were becoming quite well known, and that the sale would afford buyers a unique opportunity of securing some useful parcels of the woods.

The first lots put up by the auctioneer consisted of 30 lots of pyinkado sawn square logs which made 1*s.* 9*d.* to 2*s.* 1*d.* per ft. cube after some competition.

Twenty lots of gurjun brought 1*s.* 6*d* to 2*s.* 1*d.* per ft. cube.

There was competition to secure the round Burma mahogany logs, which realised 2*s.* 3*d.* to 5*s.* per ft. cube. These lots included some figured logs.

Squared edged teak made 2*s.* 9*d.* to 4*s.* 9*d.* per cubic ft. and teak strips 3*s.* 3*d.*

Hewn square haldu logs brought 1*s.* 9*d.* to 2*s.* 3*d.* Hewn and round ditto made 2*s* 7*d* For the haldu boards prices ranged from 3*s.* 6*d.* to 7*s.* 6*d.* per cubic ft

For round laurel logs 2*s.* to 2*s.* 4*d.* was paid, and the hewn square logs of the same wood 1*s.* 9*d.* to 2*s.* 1*d* Two lots of figured laurel logs brought 1*s.* 10*d* and 2*s.* 10*d.* respectively. One lot of hewn square laurel logs, sawn to 1½in. and ⅛in., made 2*s* 1[illegible]*d.* Another parcel of hewn square laurel logs realised 1*s.* 3*d.* to 2*s.* 10*d.*

A parcel of sawn square pyinkado logs went at 1*s.* 10*d.* per ft. cube, and a further parcel of this wood ranged from 1*s.* 8*d.* to 2*s.*

Sundry lots of hardwood planks made 1*s.* to 2*s.* 2*d.*, and the last lots, consisting of yon planks, were knocked down at 2*s.* to 2*s.* 1*d.* per ft. cube.

The special attention of dock and harbour boards, constructional engineers, etc., was drawn to the first-class parcels of pyinkado offered in the catalogue. The wood is renowned for strength and durability and is eminently suitable for piling and all dock and harbour work.

Mr. Hibbard, at the close of the sale at 3-45 P.M., announced that further parcels of these woods would be offered for sale in about a month's time.—[*Timber Trades Journal, Vol. C, No. 2616.*]

SOME HINTS REGARDING ENTOMOLOGICAL INQUIRIES

BY ROBERT VEITCH, B.SC., CHIEF ENTOMOLOGIST.

The Department of Agriculture and Stock receives a considerable volume of correspondence asking for advice as to the most satisfactory means of dealing with various insect pests, and the Entomological Division of the Department is always prepared immediately to supply whatever information is available. It unfortunately happens, however, that in many cases no specimens accompany the inquiry and, in addition to the absence of specimens, the information supplied by the inquirer as to the nature of the damage is often very limited. It thus follows that frequently no definite advice can be tendered until specimens and fuller details have been obtained by further correspondence. Such delay only too frequently means that by the time the advice is received by the inquirer the insect infestation has reached such a stage that the recommendations made are too late to be of much value in checking the particular outbreak under discussion. These recommendations will, however, always be of value for immediate application should there be any recurrence of the trouble For the reasons just enumerated I wish to impress upon every inquirer the desirability of furnishing specimens, both of the insect responsible for the damage and also of the damage done by it, the specimens to be accompanied by full details as to the nature, extent, and duration of the outbreak. I would further stress the desirability of communicating with the Department of Agriculture and Stock when the insect attack is in its early stages, for delay usually adds to the difficulties of effective control.

The following information is supplied to ensure the receipt of insect specimens in a condition suitable for satisfactory examination and identification :—

1. Insect specimens should never be forwarded in envelopes, because if they are at all soft-bodied, *e.g.*, fruit flies or aphis, they are generally so squashed in transit as to be of little value for specific identification, while the small harder-bodied insects frequently lose legs or heads in transit in envelopes.

2. Soft-bodied insects, such as aphis and thrips, are best forwarded in a small tube containing alcohol or methylated spirits, the tube being packed in sawdust or cotton wool in a tin matchbox or tobacco tin or similar container.

3. Small hard-bodied insects, such as beetles, wasps and leafhoppers, are best packed in a tin matchbox; a little cotton, wool or, failing that, some small pieces of newspaper used as packing inside the box will serve to prevent the insect becoming damaged through undue movement in transit. A drop or two of carbolic acid in the container before packing is of some value in preventing mould, and it also acts as a deterrent to the attacks of other small insects, *e.g.*, ants.

4. Ticks, fleas, mites and lice can be forwarded in spirit or alcohol in tubes.

5. Butterflies and moths should be killed as carefully as possible and placed in paper triangles made as follows:—Fold along line *a* as shown in Fig. 1, then along line *b*, then along line *d*; this forms a container (shown in Fig 2) into which the dead butterfly or moth can be slipped after its wings have been carefully folded in such a manner as to prevent the scales of the wings being rubbed off. The triangle can be closed by folding along the line *cc* and folding along *e*. Place only one butterfly or moth in each triangle. The paper triangles can be packed in a tin and forwarded in the usual manner.

Fig. 1.

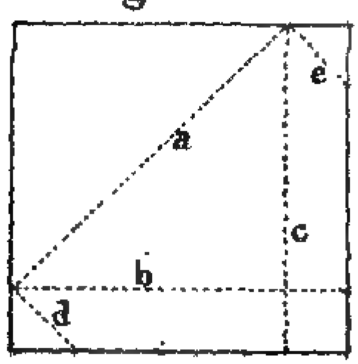
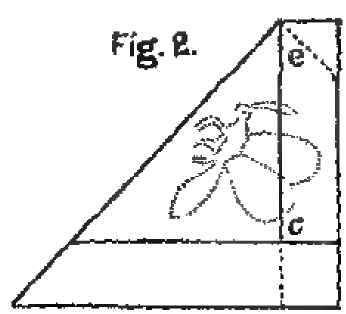


Fig. 2.



6. If the insects are in the caterpillar or grub stage and are alive, place a small quantity of their food plant in the package so that the insects will remain alive until received at the Department of Agriculture and Stock, but pack the food so that it will not move about unduly and thus injure the caterpillars or grubs.

7. If the insect has pupated place it in a tin in which its movements are reduced to a minimum by the judicious use of cottonwool or torn-up pieces of paper.

8. If the inquirer is forwarding insect-infested fruit he should on no account send it in closely sealed tins, because, as a rule, the consignments so forwarded reach the Department in such a fermented condition that the insects they contain are invariably killed by the fermentation generated in such a container; such fruit should be packed in wood wool or straw in a well aired container.

9. Large insects, such as grasshoppers, should have their abdominal contents removed before being packed in a mailing tin.

10. Where plant bugs are being forwarded it is always important to send the fully mature winged forms because the identification of the immature wingless forms is a difficult and in many cases an impossible task; in all inquiries it is desirable that the inquirer should forward as many stages in the insect's life cycle as can be conveniently obtained.

11. Insects are best killed in a "killing bott e," which consists of an ordinary strong bottle with a layer of plaster of Paris and potassium cyanide at the bottom; when this is tightly corked it becomes so charged with hydrocyanic acid gas generated by the potassium cyanide that a few minutes in the bottle generally suffices to kill most insect life.

12. Where a cyanide "killing bottle" is not available a drop or two of chloroform will be found effective in killing many insects.

Specimens of the damage should be forwarded with the insects when the inquiry is made, but it is necessary to send only

the portion of the plant that is attacked, *e.g.*, the fruit, or leaf, or root, or stalk, as the case may be.

The details to be supplied by the inquirer will naturally vary, but as a rule the following should be included :—(1) Date of insect outbreak ; (2) degree of severity of attack ; (3) area attacked ; (4) crop attacked ; (5) age of crop , (6) general health of crop apart from the insect attack ; (7) nature of soil and drainage ; (8) nature of surroundings, *e.g.*, is the farm or orchard isolated in uncultivated land or in scrub or is it adjacent to other farms or orchards ? ; (9) measures, *if any, already taken to cope* with the pest.

The forwarding of specimens and details has been dealt with at some length, because I feel that the outcome of many inquiries will be of a much more satisfactory nature if greater attention is paid to the forwarding of specimens and full details when the inquiry is originally made. All such inquiries should be addressed to the Chief Entomologist, and every effort will be made to supply all available information.

[The above article is reprinted from the *Queensland Agricultural Journal* for May 1926 for the information and assistance of Forest Officers sending insect specimens through the post. It applies even more forcibly to this country, where specimens frequently take a week or ten days, or longer, to reach the Research Institute. At present the frequency of the only possible reply "that the specimens arrived in such a damaged condition as to be practically unrecognizable" is regrettable, and in nine cases out of ten the necessity for such reply could have been avoided, by more careful packing.

Particular attention should be paid to the prevention of movement, both of the specimens themselves, and of the container, *if of glass, in which case it should invariably be packed* firmly in a second outer container.

It is recommended also that specimens should always be sent to the Forest Entomologist direct, and not through the Despatchers Divisional Forest Officer or Conservator as the case may be.—ED.].

ORIGIN OF KEW GARDENS.

At a recent luncheon of the Gloucester Rotary Club Dr. T. F. Chipp, Assistant Director of Kew Gardens, gave an able and interesting address on the origin and history of the Royal Botanic Gardens, Kew.

Dr. Chipp said that the gardens were almost unique amongst botanical institutions in not having had any connection with a university or educational establishment. As with so many of our national institutions, Kew as known to-day, was not evolved in any deliberate manner or as the result of some carefully conceived plan in the brain of any far-seeing Empire builder. Private gardens at Kew had been far famed for many years when Frederick, Prince of Wales, acquired Kew House on a long lease in 1730, and began a fresh arrangement of the pleasure grounds and additional plantations. The origin of the present Botanic Gardens was, however, rather due to his widow, the Princess Augusta, who in 1760, under the guidance of her adviser, the Earl of Bute, started a botanic, or, as it was then called, a physic garden on an area of some nine acres. Some of the trees then planted still exist. After her death George III, who had succeeded to Richmond Palace, bought the freehold of Kew House and united the properties of Richmond and Kew, and from these properties, with certain modifications and additions, the present Gardens, of an area of 288 acres, originated. George III maintained the botanical character of Kew, and in this he was greatly assisted by the eminent scientist Sir Joseph Banks, who had succeeded the Earl of Bute as botanical adviser. The King and Sir Joseph Banks, both died in 1820, and thereafter there were no marked activities in the development of the Gardens. On the death of William IV, in 1837, the position of the Gardens became precarious. A Committee was appointed to inquire into the management, and as a result Parliament in 1841 made them a national institution and appointed Sir William Hooker, then Regius Professor of Botany at Glasgow, as the first director. Under Sir Joseph Hooker, the second director, and Sir William Thiselton-Dyer, who succeeded him

the development of the activities of the institution in all its branches continued unchecked. Sir David Prain, the last director, had the difficult task of administering the institution during the Great War; he was succeeded by the present director, Dr. A. W. Hill.

For administrative purposes the Royal Botanic Gardens were under the Ministry of Agriculture and Fisheries, and the Ministry vote had to provide for their maintenance. This came entirely from Imperial funds, and the annual total expenditure is about £60,000. The speaker gave the details of the internal administration and the functions of the various departments.—[*Timber Trades Journal.*]

PICTURES OF THE JUNGLE.

MR. KEARTON'S NEW FILM.

A private exhibition of Mr. Cherry Kearton's *Jungle Pictures* recently shown before the King and Queen at Windsor, was given on Wednesday morning at the Marble Arch Pavilion—where the public exhibition will begin next Monday—Mr. Kearton himself giving from the stage a running commentary on the pictures as they were thrown on to the screen.

Of the many admirable films of wild life and of big game in its native haunts which have been presented of late, this is beyond doubt the most varied and most thrilling; and in watching it one came to understand why Theodore Roosevelt spoke of Mr. Kearton as the bravest man he had ever met. Tigers, hemmed in and mad with rage, wounded lions, charging promiscuously at anything in sight, rhinoceroses being lassoed and in extremity of wrath and terror, elephant herds suspicious and on the outlook for their enemy—of all of these we see pictures, which cannot have been taken from a distance of very many yards; but of his own share in the performances the lecturer has little to say. Once, indeed, we were told that he was guarded (from the lions) by a spearman standing on either side of him; and a wonderful "close-up" of a 17ft. python slithering

a.ong a low branch overhanging the game trail to a waterhole was taken with "one hand turning the machine and the other holding a revolver."

The range of the subjects shown is remarkable. Orangs wild in the Borneo forests; the shy, wild things of the Sahara, fennec, jerboa, and horned cerastes; tigers and elephants in India; penguins from the Far South; lesser creatures of Southern Europe, trap-door spiders and pine processionary caterpillars, but, above all, creatures of the African forest, veld, and stream, lion, rhinoceros and hippopotamus, crocodiles (with zizczac plovers to pick their teeth), tic-birds, secretary birds, and vultures, terrible armies of fighting ants, oryx, wart-hog, and zebra, baboons and colobus monkeys, and the rapidly disappearing aard-vark; an extraordinary collection of pictures for any man to have made in a single lifetime. Thrilling to the last degree is the spearing of lions by Masai warriors. Delightful are the scenes at an African waterhole, wherein the chief performers are oryx, impala and baboons; and more delightful still the achievements of Togo, a young chimpanzee, which has an epic combat with a giant rat, goes round spanking wild zebras, and chasing a cheetah or hunting leopard for the fun of it.—[*The Times.*]

GREENHEART.

Mr. B. R. Wood, Conservator of Forests, has issued a pamphlet from the Forestry Department, at Georgetown, British Guiana, for general information on the merits of greenheart timber for marine and other issues, from which we publish the introductory remarks concerning this useful and unique wood, as follows:—

The true Greenheart (*Nectandra Rodiæi*) occurs in commercial quantities only in the north central portion of British Guiana, behind the coastlands, and principally in the area drained by the Cuyuni, Mazaruni, Essequibo, Demerara and Berbice rivers. In these areas it avoids the drier and poorer soils, growing largely on the slopes leading down to the streams. It is also found in the damp ground near the streams, provided the conditions do

not approach too closely to true swamp, but in such situations the tree is not so big, nor the quality quite so good as on the slopes, nor are the stands per acre anything like so great as a rule.

There is a very large quantity of this wood remaining in the Colony, the former workings having been almost all in the vicinity of the navigable streams, and this large quantity awaits development by more modern methods of logging than have been adopted in the past. Some idea of the quantity remaining to be worked can be gauged from the fact that the area of forest over which greenheart is known to occur is approximately 20,000 square miles, whilst strip valuation surveys carried out recently by the Forestry Department by methods which have been adopted and shown to be accurate by the United States Forest Bureau, Philippines, British North Borneo, and Malay States Forest Services, and which have been in use by the Indian Forest Service in Burma for many years, have disclosed, on an area of 400 square miles, commencing at six miles from a port at which steamers up to 15 feet draught can load, a total stand of 77,000,000 cubic feet of sound mill timber 16 inches diameter at breast height and over, whilst the true greenheart forest in this area carried good stands, one compact area of 70 square miles averaging throughout the whole some 640 cubic feet per acre, and this area almost certainly extends to another 100 square miles. After the valuation of 400 square miles in the area, the triangle of lands having Bartica as its apex, the Essequibo and Mazaruni rivers as its sides, and a line drawn from Tiboko to Potaro Mouth as its base, a total area of 2,360 square miles, is estimated to contain above 300,000,000 cubic feet of sound merchantable greenheart timber. It is thus seen that there is little fear of a failure of supplies of greenheart in the near future.

The tree is a moderate sized to large one, only slightly buttressed or not at all in the good greenheart area, although the buttresses tend to become larger in more swampy ground. The boles are long, straight, and very clean, with a moderate taper and good timber form. On the average 19 per cent. of the trees are unsound. Hewn logs of shipping specification are

obtainable from 10 inches to 25 inches square caliper measure, squares above 21 inches not being common and generally carrying a somewhat higher price. Log-lengths are usually from 30 to 70 feet.

The timber has been known for very many years:—Bancroft in his Natural History of the Guianas, published in 1769, describes the Greenheart tree, and draws attention to its usefulness. In later years several cargoes of the wood were sent to the Clyde and Liverpool, where it commanded a higher price than any other wood on the market. There has been a regular export trade in the wood ever since.

Greenheart is a first-class ship-building timber and is placed second of the eight woods rated at A-1 at Lloyd's, teak being the only wood above it. Where great strength is required greenheart is supreme. Nansen's ship "The Fram" was strengthened throughout with greenheart and the Antarctic ship "Discovery" built of it, but it is in marine work, under water, that greenheart has the greatest reputation, and is in the most constant use, being more immune from the attacks of Teredo in salt water, than any other timber. —[*Timber Trades Journal.*]

SPRUCE FIR.

Although spruce fir does not possess the strength and durability of Scotch fir or larch, it is highly valued on account of its lightness, softness of texture, and the facility with which it may be worked. Spruce fir (or white pines), like other firs, are influenced by the nature of the soil in which they grow, a sheltered situation and rich soil proving deleterious to the quality of the timber, whilst trees grown in siliceous soil and on exposed regions yield timber of the best quality. The tissues of these trees are composed principally of cellulose incrusted with lignose and sometimes also with calcium salts and silica. Spruce, like all soft and light wood, usually contains a smaller proportion of incrusting matter than hard woods.

The percentages of the various constituents present change with the different seasons. With trees of the fir tribe the maxi-

mum water content is in winter, and the minimum in early summer. In the case of a slow growing tree, the water content is less than one of the same species rapidly grown. Spruce fir contains most sugar in the spring, when the reserve starch is undergoing solution, the sap wood containing more than the heart wood. The proportion of sugar present in autumn and winter is relatively small.

Circulating ash constituents act as plant food for the trees, and are concentrated in the actively growing tissues; on the other hand, in the incrusting matter there occurs an accumulation of ash constituents with increasing age. The latter consist of small proportions of potash soda, lime, magnesia, ferric oxide, manganese oxide, sulphuric acid, silica, chlorine and carbonic acid. Firs grown on calcareous soil possess less silica and substantially less potash, but more lime than the ash of the same tree grown on siliceous soil.

In the sap wood of spruce the ash is at its maximum in autumn and winter, but in the old wood the ash is at its minimum at these seasons. In spring the ash in the sap wood falls, whilst it ascends considerably in the bark, in the innermost layer of which active growth has begun. By summer the ash ingredients in both sap and bark have reached their minimum, the circulating ash constituents having for the most part, been transferred to the leaves. When the latter wither, part of the ash returns to the parent stem and remains in the sap wood to be used for the following year's growth.

In the bark of spruce the percentages of potash and magnesia are usually smaller than in the wood, proportions of lime and silica and possibly alumina, are greatest in the bark, in some cases alumina being a large constituent. The silica content is particularly rich in the outermost layer, which provides a siliceous skin protecting the stem from infiltration and from the attacks of fungi and insects. In spruce the outer layers contain more sulphuric acid and iron than the inner. The silica content increases with increasing age, whilst simultaneously a reduction occurs in the proportion of lime. The latter, existing in the form

of insoluble salts is readily absorbed and retained by the wood. On the other hand, it is evident that potash exists in the form of soluble salts, probably organic salts, for the woody tissues display little retentive power. In fact, floating timber down streams removes a substantial proportion of its potash A log of spruce placed in running water displays, after a lengthy period, an outstanding loss of ash constituents. Any acidulous condition of the organic substances, caused possibly by fermentation, eventually results in rotting timber.

Sometimes very serious losses are incurred by rotting in the stacked wood Experiments conducted with equal volumes of sound and rotten spruce over a period of one year, resulted in a loss of 75 per cent. of wood substance through rot in the wood. It was demonstrated that a block of sound spruce contained 58 per cent. of cellulose, whilst a similar block of infected spruce contained approximately a quarter of that amount.

In pulp mills the losses incurred were calculated as follows:— Loss through rotting, 6 per cent. to 9½ per cent.; loss of strength in the pulp, 11 per cent to 18 per cent as a general rule, but in some cases as great a loss as 48 per cent. was incurred. Fungi and bacteria infected the stacks in certain parts. Some of them got through into the mechanical pulp, and during storage red and white patches appeared in the pulp laps.

During boiling tests made on spruce it was found that if rot had not advanced beyond discolouration, infected wood might still be suitable for sulphate pulp The drop in weight and low yield of fibre was sufficient evidence of the disastrous effect resulting from the employment of decayed spruce. In one mill an increase of from 0·7 per cent. to 1·5 per cent. on cost of production was experienced for each one per cent of rotten wood used, without taking into account the ultimate reduction in output.

As spruce is more predisposed to decay than any other species of the fir tribe, it is advisable to stack this most useful timber under cover, where there is a free circulation of air and no infected wood in the vicinity.—[*The Timber News.*]

KENYA TIMBER INDUSFRY.

The timber industry in Kenya has recorded very slow development, except in the production of cedar slate for the manufacture of pencils, despite the protection afforded by a heavy duty imposed on imported wood, writes the Nairobi correspondent of the *Times Trade Supplement.* It has been contended that one of the handicaps imposed by the Government was the rate of royalties, and the Government appointed a Select Committee of the Legislative Council to report upon the question.

It is perhaps unfortunate that the Committee decided to comfine their examination to consideration of royalties alone instead of investigating the associated problems of forest policy, because Kenya, despite Professor Troup's expert report, still requires a progressive forest policy, and is in search of a suitable officer as Conservator of Forests.

The report indicates that since July 1919, all royalties for timber, except small quantities, have been the subject of tender, after public advertisement, licenses having been granted to the highest tenderer, on the other hand, there are 13 sawmilling concerns at present holding licenses issued before that date who pay royalties fixed by the Forest Ordinance of 1915, and one large concessionaire is operating under special conditions. Since July 1919 six sawmilling concerns have been licensed under the new tender system.

The Committee, in view of the fact that royalties fixed by public tender since 1919 were greater than those fixed by ordinance before that date, saw no reason to recommend any change in the present system.—[*The Timber News.*]

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FEBRUARY 1927.

SOME IMPRESSIONS OF AUSTRALIA.

As the *Indian Forester* accepts from time to time articles on travel to little known places it has occurred to me that an account of a visit to Australia may be considered of sufficient interest for insertion. Possibly some readers may consider that Australia should not be classed as a country 'little known' but as regards this I would point out that if it were well known the people who live there should have the best chance of knowing it. The people who live in the eastern side of the island know nothing about the western side and consequently those that do not live there at all are probably equally ignorant.

Before going to Australia I decided to see both the west and east so that although I was warned more than once (by people who lived on the east) that there was nothing to see in the west I still decided to go there. I am of opinion that if one wants to know anything about Australia it is best not to ask an Australian as in nine cases out of ten he will say that Sydney or Melbourne, according to whether he lives in one or the other, is the only place worth seeing. If he happens to live in Sydney he will be right to some extent as Sydney certainly is worth seeing, but Melbourne is merely a huge waste of wooden shanties with tin roofs crying aloud for a bush fire to come along and wipe it off the map. It is possibly a perverted sense of patiotrism that makes a man from Sydney or Melbourne ignore the whole of the rest of the island, or maybe it is shortsightedness that prevents his seeing beyond his own parish.

There are many striking differences between the west and the east of Australia. In the west very good English is the language of the people. The visitor to Eastern Australia will get along nicely if he can understand the language current amongst the ragged urchins who play in the streets of the poorest parts of the east end of London. If he can speak this language he might easily pass for a native in Melbourne. In West Australia there is not so much habitation as in the East and consequently as the country is very large, destruction is not so advanced and there are considerable areas in which the original vegetation remains to be destroyed. The people, however, are vigorous and the forests burn well, so that it is surprising how much has already been achieved.

One of the principal occupations in rural Australia is taking up land. This consists of acquiring a piece of land carrying forest growth of sorts. All the timber trees are "rung," *i.e.*, girdled, some of the smaller ones are cut down and when the whole country is dry enough to make a fire really worth while, one is started and clears not only the settler's block, but quite a number of adjoining areas as well. This is the first step in turning useless bush into valuable pasture or agricultural land, but it does not often seem to go much further The settler having started the job either discovers that the land is of no use or gets discouraged or hears a rumour of gold having been discovered in some distant district or for some other reason leaves the land. The next rainy season produces a magnificent crop of seedlings. After a lapse of some years, by which time the regrowth is becoming nearly big enough to make telephone poles, another settler comes along and takes up the land and the process is repeated.

Occasionally the process goes much further and the bush is got under control, grass or blackberries replacing the original vegetation, and the settler builds a house on his property The next step is to put up a notice saying the place is for sale and wait for a purchaser. The price asked is sufficient to enable the settler to live the rest of his days in the suburbs of Melbourne or Sydney. Nearly half the people of Australia live in the suburbs of Melbourne or Sydney, the rest live in houses they are trying to sell.

Australia is probably the most governed place in the world. In Great Britain one Parliament has to try to cope with affairs of some 40,000,000 people as well as to meddle with foreign countries, so that it is not to be wondered at that much gets overlooked. In Australia, there are seven Parliaments for 5,000,000 people, and as all ordinary crimes have long ago been considered and appropriate remedies been legally enacted, they are now forced to invent offences. In this they have been highly successful, but the foreigner is apt to find that many of his customary acts and most of his amusements are criminal offences in Australia. I should imagine that it takes several years to find out exactly what is and what is not tolerated in Australia. Luckily the cost is uniform, *viz.*, £2 per offence. Whether second offences are looked upon more seriously or not I do not know as I did not stay long enough in any one State to commit the same offence twice or to be more accurate I did not get caught twice. Anyway it adds to the cost of a visit to Australia and the tourist should set aside a considerable sum to meet the charges. The following is a sample £10 worth of Australian crime I committed all these but it did not cost the full £10 as I got away with some of them :—

(1) Putting a foot or feet on the seat of a railway-carriage—£2

(2) Crossing a street in Melbourne at an angle other than a right angle—£2.

(3) Bathing on Manly Beach, Sydney, in a one-piece Oxford swimming costume instead of a two-piece Canadian costume—£2.

(4) Smoking in the Botanic Gardens, Melbourne—£2.

(5) Wheeling a bicycle through the Part Frankton, near Melbourne, on a Sunday—£2.

As regards Crime No. 1 I advice the visitor to put both feet on the seat as it is far more comfortable and costs no more than one foot. One has to pay the cost of a sleeping-berth in Australian trains and one soon accepts the cost of footstool.

As regards Crime No. 2, the simplest thing is not to go to Melbourne. I cannot imagine anyone wanting to cross a street

there unless it were the shortest way of escaping from the place altogether.

I offer no advice as regards Crime No. 3, but merely give my own experience. After finding that an Oxford swimming costume was considered indecent in Sydney, I bought a local standard pattern one approved by the City Fathers. Now in Australia they grow no cotton. This staple has been tried in Queensland but I do not know the result. Probably the farmer sold the place and retired to the suburbs of Sydney before the crop had time to mature. The result is that in Australia swimming costumes are made of wool. Mine was quite all right till I got wet. I was then run in for not "being covered from above the neck to below the knee." Deficiencies at either or both ends cost £2 as usual and as I still had to pay for my passage away from Australia I thought it best to husband my resources and give up bathing on public beaches.

Crime No. 4.—This £2 I grudge and feel that it has warped my views of Melbourne. If I had only known I should have smoked in the orchid house and dropped the cigarette end in the pitcher of a Nepenthes and had some return for my money; but to pay £2 just for sitting on a seat in the open air and smoking a cigarette seems throwing money away.

Crime No. 5.—This was my own fault and due to getting in arrears with my diary. I knew the law as there was a big notice up at the entrance of the park, but I thought it was a Saturday. I have forgotten what happened if you rode a bicycle through the park on a Sunday but think it was gaol with no option.

The visitor to Australia should be warned of the hardships of railway travel. I was warned myself and heeded the warning, not so much because a journey starting at 7-15 A.M. and ending at 9-15 P.M. sounded formidable but because the little seaside place at which one could break journey sounded attractive. The journey as I afterwards discovered was equivalent in general wear and tear on the system to about a week in the train in India. It can be quite hot in Australian trains but no fans were provided in this one. The timing of the train allows for several derailments and one head on collision in the day. As we had no accidents

we had to waste time in other ways. There are no particular arrangements for meals but at certain stations a halt of 8—10 minutes is made during which time a cup of tea and a sandwich can be procured if the tea-stall happens to be opposite the carriage in which one is travelling. If, as is more often the case, it is at the other end of the platform, one finds oneself at the outer edge of a famished crowd clamouring for food and the 10 minutes is gone before one's turn to be served comes. Trains never wait more than the fixed 10 minutes at these refreshment stations, the odd half-hours are spent in places where there is nothing to do. The railway, I suppose, contracts to stop the train 8 or 10 minutes at certain stations in return for someone opening a tea-stall and then takes special steps to see that the stall holders do not get any advantages they are not entitled to. The stations selected for refreshments are not evenly spaced along the line as two adjacent stations may be tea-stall-stations and then there may be a 3 hours' run with none. They are not designed so as to afford travellers food at the normal meal-hours. I think some one must apply to be allowed to open up a tea-stall at some station near his home and thereafter this becomes a tea-station. One soon gets used to swallowing scalding tea in Australia and learns to take it as often as it is offered as one never knows how long one may be before getting anything more. The first journey I did in Australia was one of 200 miles timed at 14 miles an hour, but it is only fair to add that the train reached its destination half an hour before its scheduled time.

It is not possible to do a long journey in Australia without " breaking gauge." By this I mean a journey long in distance not in time. The Australian railways are only just out of the experimental stage. Each State had its own gauge as they could not tell without a good trial which gauge was the best. Recently it has been decided that a gauge of 4ft. 8½in. shall be adopted throughout the island. This decision made it possible to build the Trans-Australian Railway (known in Australia by its pet-name of " The Trans," pronounced to rhyme with " pans " not to rhyme with " chance "). There are no engineering difficulties

in the way of this line as there is neither a river to bridge nor a hill to tunnel throughout its length, nor are there any towns to necessitate detours from the best route. The difficulty hitherto has been to choose a gauge West Australia uses a 3ft.6in gauge and of course wanted this to be used for the Trans South Australia wanted 5ft. 3in. By choosing a gauge of 4ft. 8½in. both West and South Australia are equally handicapped as neither of them can use the line which is worked as a separate unit. This gauge of the 4ft. 8½in. is justified for the Trans. as it has been resolved, that in time all the railways in Australia shal be on this gauge, meanwhile beyond building on this gauge in parts of Australia where it has not hitherto been seen with the idea that the people will get used to it and in course of time may even realise its advantages, nothing has been done and each State continues to build new lines on its own pet gauge.

Before leaving the question of railways, I ought to mention that the best electric railways in the world are in Australia, being the suburban system of Melbourne. In case the visitor should not know that this system is the best in the world, posters at all the railway stations inform him of the fact. As I was bound for Frankton and this place is on the Melbourne electric system, I had the advantge of being able to travel by it. The organization is wonderful. Big notices at the entrance to each platfrom proclaim the routes followed by the trains leaving from the various platforms. There is no need to enquire the way as a notice informs you that Frankton trains leave from No. 7. By bad luck I just missed one train and had ¾ hour to wait for the next. The time passed quickly enough as trains left at frequent intervals for various destinations, an illuminated electric sign showing the route and stops. The hour for the Frankton train arrived and the sign did not show Frankton so I asked a porter if the sign had got out of order and was informed that nothing ever did get out of order on the best electric system in the world. On pointing out the specific instance of the Frankton train I was informed that it always left from No. 1 and sure enough on getting to No. 1 I found the train had just left! As there was another ¾ hour to wait for the next train I had time to revise my

opinion of "the best railway system in the world" and also to ascertain the purpose of the signs and notices. It seems that even 3rd rate systems use such signs so of course the best in the world must have them too. They are intended to impress the visitor, not to be taken seriously. If you want any information you can always ask a porter. The railway staff will not allow the signs to be made reliable, as if they were, there would be no need for the swarms of officials who occupy the station and if not otherwise engaged answer the questions of would-be travellers. Thus numbers of men earn a livelihood and there is rarely any inconvenience to anyone. Now and then, I suppose, a visitor gets caught but that is his own fault for visiting Melbourne. Most of the people using the railway are local inhabitants trying to get away and I suppose the local people know all about the railway and take care that it does not stand between them and their determination to get to pleasant surroundings.

Having warned the would-be visitor of some of the pitfalls to be anticipated in Australia, I find that this article has become too long for me to start enumerating the numerous attractions of the country and people. This must be left for a future instalment. In case these preliminary remarks should lead to a false impression, I must sum up my views by saying that I know of no country in which one could spend a more enjoyable holiday than Australia.

T. O. H.

REGENERATION WORK IN NORTHERN BENGAL.

1.—Previous History.

1. *Plains.*—The causes of the failure of natural regeneration especially of sal and the consequent prescription of artificial regeneration of this species in recent working plans for plains divisions in Northern Bengal have been traced and explained in the working plans themselves and in Indian Forest Record, Vol. VIII, Part IV and the *Indian Forester* for April 1914.

Briefly, the success of fire protection in the plains forests led to the establishment of dense evergreen undergrowth and small climbers which together prevented sal seedlings from establishing themselves; and regeneration, which had been abundant as long as the forests were annually burnt became less and less, and finally ceased. 1914 may be assigned as the year when the failure of natural regeneration became an accepted fact.

Experiment had been made to find out if artificial assistance could be given to natural seedlings but results were negative and the question as to the best means of artificially regenerating sal had to be faced.

The results of all the experiments carried out indicated the *taungya* method of regeneration as the most promising and this method had to be prescribed in working plans even before it had been thoroughly tested in practice.

2. In the Duars and Terai forests, the artificial regeneration of sal entailed similar treatment of some other species. Only those portions of any coupe which are exactly suitable for sal can be satisfactorily stocked with it, and it is very rare to find continuous large areas suitable for sal. To secure full stocking those parts of any coupe which are not suitable for sal must be stocked fully and rapidly with other species. The desire to improve unstocked or poorly otscked areas outside the sal bearing forests, especially where labour was available, was a further incentive to work with species other than sal

3. *Hills.*—In the hills large areas of inaccessible forest remain unworked to this day but in the accessible parts regeneration problems had to be faced at a much earlier date than in the plains, and nursery and plantation work figure in the earliest Administration Report, that of 1864-65. In the earliest working scheme ("Suggestions regarding the Management of the Forests in the Jalpaiguri and Darjeeling districts, Bengal") Sir D. Brandis in 1880 remarking on the scarcity of seedlings of valuable species concluded that natural regeneration would not suffice to restock the forest, and advised artificial reproduction. The method

suggested for forests below 7,500 ft. was partial clearances with planting in horizontal lines on favourable ground.

Sir W Schlich's "Memorandum on the Management of the Forests in the Darjeeling division, Bengal," written two years later (1882), contained similar but modified proposals, and during the currency of this plan attempts were made to secure natural regeneration by successive fellings with some success.

4. In general, the fellings made were not as severe as those prescribed and planting was allowed to fall into arrears. The first working plan for Darjeeling division, that of 1892, by Mr. F. B. Manson, was very full and detailed. He proposed to bring the forests into a regular condition and to effect regeneration under a shelterwood. The rotation chosen was 160 years and the forest was divided into five periodic blocks, block I to be regenerated in 32 years. The annual coupe was $\frac{1}{32}$th by area of block I, and from this area up to half of the standing crop was to be removed in a "Regeneration Felling," designed to leave a lofty canopy under which valuable advance growth would be left and regeneration completed partly by natural seedlings from the seed bearers and mostly by planting in lines 20 ft. apart at 6 ft. intervals. Shelter of this nature was considered to be desirable if not actually essential for the success of planting The balance of the crop was to be removed when considered desirable.

Ten coupes were taken in hand, and on the revision of the plan after ten years, removal of the shelterwood was prescribed in these ten coupes and no fresh "Regeneration Fellings" were to be made. At that time it was obvious that the removal of the shelterwood must cause a lot of damage to the new crop, which damage would be greater the longer the final fellings were postponed.

The damage was actually very great, as lopping before felling had not then been introduced, and the second planting, which was intended to be supplementary to the first, in many places had to be original planting

5. The next plan, that of 1912 by Mr. Grieve, was designed to avoid a second felling over a regenerated area and to utilise

advance growth to the fullest extent possible. He describes natural regeneration as "*usually fair and sometimes of the highest order*" and proposed felling the mature crop in groups where advance growth existed, lopping being done before felling to avoid damage. It was hoped that natural regeneration would extend as a result of the opening of groups. Dibbling of seed at stake and planting were prescribed where advance growth was insufficient. Fellings were made in accordance with this plan for five years and then stopped. The fellings did not have the hoped-for effect of inducing natural regeneration, and it was found necessary to do considerable planting in the groups, which really became clear fellings in patches. For the next five years fellings were made with a view to converting the groups into clear fellings, and restocking was done by sowing and planting. Felling in groups had the further disadvantage of making the control and supervision of work in the forest very difficult and this method was therefore abandoned in favour of clear felling and planting in the plan of 1921 by Mr. Baker who did not share Mr. Grieve's sanguine views regarding actual or potential natural regeneration. The *taungya* system had just been tried in Kurseong division with promising results and was therefore prescribed in this plan.

(The earliest record of a *taungya* plantation in the Darjeeling district is contained in the Annual Report for 1868-69. An area of two acres was sown up departmentally with potatoes with the object of getting well cultivated ground for planting without increasing the net expenditure. It is unfortunate that beyond a bare remark that "potatoes are an unsuitable crop for this purpose" in the following year, nothing further is recorded).

6. Manson's plan insisted very strongly on the necessity for some shelter over young plants and was designed to give that shelter. His system of working was abandoned because removal of this shelterwood involved much damage to the crop established under it. The idea of giving shelter was maintained in Grieve's plan, but in practice the groups became small clear fellings, and hence only side shelter to a greater or less degree was actually given. The step from these small clear fellings to large ones

was next made and now no shelter at all is provided and restocking is practically entirely by artificial means.

II.—PRESENT METHODS OF REGENERATION AND SHORT SUMMARY OF THE RESULTS OBTAINED UP TO DATE.

7. *Duars and Terai*—For sal the *taungya* system is still regarded as the only satisfactory one. The procedure has altered very little from that described in the Forest Record—minor modifications include:—

(I) The sowing of seed in three lines 6 in. to 1 ft. apart when seed is abundant. This gives a very large number of young seedlings, and makes the formation of blanks by faulty germination, drought or pig damage, less frequent.

(II) The planting of the secondary species during the first year of cultivation. In the earlier plantations, sal was sown all over the area in the first year, and seedlings of other species were planted in the second year in places where the sal had failed. This lost a year's growth for the seedlings of the secondary species which were further liable to be held in check by the second year's field crops and hence to have a bad start in the struggle against the weed growth which invades the area as soon as cultivation has ceased. Further, sal may do well for one or two years on a site quite unsuitable for its subsequent growth. It is clearly desirable to determine at the beginning which areas are suitable for sal and at once to commence stocking the remainder with other suitable species.

(III) The use of an auxiliary plant too keep down weed growth. In Burma teak *taungyas* some cheaply established tree species is used for this purpose, but in Northern Bengal we have so far been unable to find a suitable tree and have used a shrub (*Tephrosia candida*) for the purpose, with promising results.

8. In a normal seed year little or no difficulty is experienced in getting a full stock of seedlings to come up. Subsequent tending of the young crop has, however, proved to be a much heavier charge than was anticipated and it is now recognised that cleanings and weedings must be continued until the plants are four

years old at any rate. In some places a climber known locally as "*kowchu*" (*Mucuna* sp.) has proved a formidable foe to the young crop. This pest will smoother sal saplings up to 15 ft. to 16 ft. in height over considerable areas. It grows with enormous rapidity reproduces itself profusely by seed and also sends down roots from the stem, each such root forming a centre from which spreading takes place. Its extreme rapidity of growth renders ordinary cutting of no avail as a protective measure and thorough eradication is the only cure. As a preventive measure against this climber and also against other weed growth, the land between the lines of sal is now sown thickly with *Tephrosia candida* after the removal of the second year field crops.

9 The areas that can be taken in hand depend entirely on the labour supply. In South Borojhar range in Buxa division—where a good number of forest villages existed when the prescriptions for *taungya* came into force in 1920, the working of the four Sal Working Circles has resulted as below :—

Period	Area prescribed for sal clear felling	Area actually clear felled.	Area planted up.
	Acres	Acres	Acres
Five years ending 1924-25. .	1,110	519	329

In the other three working circles, in Rydak and Bholka ranges, practically nothing could be done

The combined figures for the Sal Working Circles only in Jalpaiguri and Buxa divisions are given below :—

Period	Area prescribed for felling.	Area felled.	Area regenerated.
	Acres.	Acres.	Acres
Jalpaiguri—6 years 1919-20—1924-25.	4,458	770	535
Buxa—5 years 1920-21—1924-25.	1,935	526	561
	6,393	1,296	1,096

These figures show that we are now only regenerating about one-sixth of the area which we are required to regenerate each year. In view of the absence of the younger age classes from the existing crop, the position as regards regeneration cannot be considered satisfactory.

10. In almost all places where sal has been planted in the Duars and Terai, some form of wire fencing has been absolutely necessary to prevent the destruction of the young crop by wild pigs, which eat with avidity the carrot-like roots of sal seedlings, especially those of 1½ year old plants. It needs a good strong fence, well erected and well kept up, to exclude pigs from areas containing their favourite food. "Hercules" wire fencing 49 inches high has proved satisfactory and where the fence encloses species liable to damage by deer two or more stands of barbed wire are put above the "Hercules" fencing.

Fencing adds considerably to the cost of formation, especially as the areas dealt with are generally small and hence have a large perimeter as compared with their area. For example, the cost *per acre* of fencing a square area of 40 acres is exactly twice the cost *per acre* of fencing a square area of 160 acres.

11. The actual costs of formation excluding fencing of some recent *taungya* plantations are given below :—

Locality		Year of planting.	Species.	Area in acres.	Total expenditure excluding fencing up to 31st March 1926	Expenditure per acre.
					Rs. a. p.	Rs. a. p.
Borodabri		1920	Sal	22	254 11 0	11 10 0
"	...	1921	"	33	256 3 0	7 12 0
"	.	1922	"	42·5	261 5 0	6 2 0
Mendabari	..	1920	"	26	452 14 0	17 6 0
"	..	1921	"	32	310 4 0	9 11 0
"	...	1922	"	34	279 15 0	8 4 0
Poro	..	1920	"	26	283 6 0	10 14 0

Locality	Year of planting	Species.	Area in acres.	Total expenditure excluding fencing up to 31st March 1926	Expenditure per acre.
				Rs. a. p.	Rs. a. p.
Poro ..	1921	Sal	18	206 2 0	11 7 0
" ...	1922	"	20·2	174 2 0	8 11 0
Nimati	1920		20	*664 0 0	33 3 0
" ...	1921	"	13	75 12 0	5 13 0
" ..	1922	"	12·5	48 12 0	3 14 0
Nilpara ..	1920	Miscellaneous	25	443 2 0	17 11 0
" ...	1921	"	20	270 7 9	13 8 0
" ..	1922	"	25	289 1 3	11 9 0

12. Tending having proved more laborious than was anticipated it has not been possible for the villagers to work up to the standard originally set, namely, one acre of new plantation per household per year, but some villages in Buxa division have approached this figure, others do about half as much. The best results are :—

Village.	No. of houses.	Average area planted per year, 1921 22 to 1925-26.	Average per house per annum.
Poro ...	37	27 2 acres.	·73 acres.
Mendabari..	48	33·6 "	·70 "
Borodabri .	60	39·1 "	·65 "
Nimati ...	28	20·0 "	·71 "

* NOTE. The higher expenditure on this plantation was due to an invasion of "*kowcha*" (*Mucuna* sp.).

13. The following species have been found suitable for subsidiary planting in sal bearing areas :—

	Remarks.
Champa (*Michelia Champaca*) ...	Rather difficult to transplant.
Toon (*Cedrela Toona* or *microcarpa*).	Easy, but always damaged by twig borer.
Kainjal (*Bischofia javanica*) ...	Easy and does well on low ground.
Gumbhar (*Gmelina arborea*) ...	Grows too fast and branchy unless pure.

14. Sal grows so slowly in the early years that two years' field cultivation is necessary to give the young plants a good start. In non-sal bearing areas, and using species of faster growth, one year's cultivation is sufficient to establish the tree crop, and unless the yield from field crops is good the vi lagers will prefer to take up a new area each year as, *e.g.* at Godamdabri in Buxa division.

On still poorer soil the yield from the crops may be so poor that the villagers will not willingly grow them and perfer to clear and cultivate the land and then plant trees without taking a field crop, devoting their own time to their more productive wet cultivation, as for example at Nilpara in Buxa division

In fact in the plains the only villagers who regard the yield from their *taungya* as a valuable part of their annual income are the Garos and Mal-Paharias. The other villagers make their *taungya* cultivation because they must do so to secure the privilege of wet cultivation within the forest reserve. It does appear, however, that where Garos are working side by side with Madesias the latter are beginning to take more interest in their dry cultivation and are learning to expect and to get some produce of value from it.

15. The ideal conditions from *taungya* cultivation are not present in the Duars and Terai. Bamboos are absent and in Burma without these to give a hot fire, the Burmese *ya* cutters will not take up work.

Our villagers cannot get a hot fire all over the area so they have far more trouble with weeds than the Burmans, and get less valuable crops. They do, however, get the benefit of the wire fencing round their cultivation and this is appreciated.

16. Two modifications of the normal *taungya* method have been tried in the Duars and Terai.

(I) At Rajabhatkhawa in Buxa division a concession was given for the exploitation of all timbers other than sal over an area of some 120 square miles—the maximum area to be clear felled annually of species other than sal being approximately 2,000 acres. This area was made into a Working Circle and the working plan prescribed the extraction of half of the sal standing on the area clear felled of other species in any year, and restocking by *taungya* or otherwise. Villagers could not be persuaded to come to the place because there was no wet cultivation to act as a bait, and arrangements had therefore to be made to restock without their assistance. A labour force was collected and organised on the lines of a tea garden force Fortunately for the peace of mind of the forest officers concerned, the concession was never worked to anything like the maximum amount permissible Of the area clear felled only a comparatively small portion was suitable for restocking with sal. This area was restocked, and of the remainder as much as could be undertaken with the available labour was planted with other species—the balance being left to restock itself naturally by coppice and natural seedlings. The areas dealt with in the last five years are shown below:—

Area clear felled.	Area restocked with sal.	Area stocked with other species.
Acres.	Acres.	Acres.
2,783*	178	541

*NOTE —This includes the area which remained under the unfelled portion of the original sal crop, and also large areas of low-lying land unsuitable for planting The Company holding this concession ceased work in August 1923, but the concession has recently been taken up by another firm

The method of regeneration was as follows :—

For Sal.—After cleaning and burning, lines were hoed through the area 6 ft. apart and about 1 ft. wide, and these lines were hoed again just before seed time. No field crops were used at first and all cleanings and weedings were paid for. This naturally raised the cost considerably above that for *taungya* plantations, as the conditions which in the latter are secured free as a result of the cultivation had to be brought about by paid labour. Fencing was necessary—but as the areas were larger—the cost per acre for fencing was less than for the *taungya* areas.

At first the other species were raised in nurseries and planted out in prepared pits, but later it was found that direct sowing in lines gave as good or better results with less cost, and nursery work was reduced to raising such species as *champ (Michelia Champaca)* whose seed is scanty and germination uncertain, and small quantities of other species for filling in vacancies.

It must be remembered that this task of restocking a large area was thrust suddenly on the Forest Department and that at the beginning we had little or no experience of nursery and plantation work with the species which had to be used.

Results generally have been good, but the cost has been high. The average per acre in the year of formation being —

Rs. 35 per acre for sal.	Excluding fencing.
Rs. 45 „ „ for other species raised in nurseries.	
Rs. 33 „ „ for other species sown direct.	

The total cost to date has been from Rs 60 to Rs. 90 per acre for established plantations, but it must be remembered that these were the first attempts with this method of working and costs were naturally higher at first.

Throughout efforts were made to get people to cultivate crops on the area. Cotton was the first crop tried and was grown by a contractor with hired labour. More recently other field crops have been grown by members of the labour force. The cessation of work by the holders of the concession made it neces-

sary to return to the unplanted parts of old coupes—and now some acres of this are under cultivation preparatory to sowing. The labour force will have to be maintained for tending work, but it is hoped that they will extend their cultivation in the coupes and so lower the costs of formation. The cost in the first year was Rs. 13-8-0 per acre only.

(II) The second modification was tried at Sukna in the Terai. A fair demand existed for sal, other timber and also for firewood, *i.e.*, for everything obtainable from a clear felling, but villagers who would undertake ordinary *taungya* were again not available. It was, therefore, decided to grow crops departmentally—utilizing local labour on payment. The financial results of this departmental agriculture were at first disappointing—somewhere or other there was always a flaw in the procedure. If crops were good, marketing of them was bad and in some cases harvesting cost almost as much as the crop realised In spite of this an area was clear felled and stocked each year from 1919 onwards and the plantations are generally good, some excellent. Cost has been much less than in the plantations of Rajabhatkhawa but occasionally more than in the normal *taungya* plantations.

In the last two years the agricultural crops, especially jute grown for seed, have shown a profit and consequently the cost of formation has come down very considerably. In this place there is still no prospect of suitable villagers becoming available to take over the work of cultivating field crops and therefore this modified form of working is likely to be carried on. It is possible that this form would also be satisfactory in other places where, although villages have been established, the villagers do not understand and value dry cultivation. Tending has proved difficult in this second modification of the *taungya* method as the labour force which was adequate when work started has to undertake an increasing amount of tending work each year. Unfortunately it has not been found possible to increase the labour force or to get outside labour to assist

Area worked.—170 acres since 1920. Average per year approximately 30 acres.

17. *Hills.*—In the hills where cultivation of the clear felled area is possible, it is undertaken by men who work at timber extraction, sawing, charcoal burning, etc., and not by forest villagers or employees. Most of the regeneration is by planting from nurseries which are made by the Forest Department. The cultivator receives seedlings from the nursery and he plants them and tends them free for so long as he continues to cultivate the land, generally two years. The cost of formation to the Department is therefore the cost of nursery work plus the cost of tending after cultivation has ceased. Owing to local land hunger, cultivators are readily obtained for any land which will produce a good crop of maize or potatoes, and it is now possible to undertake almost the full area prescribed by the working plan. Thus in Darjeeling division from 1920-21 to 1924-25 (*i.e.*, during the currency of the present working plan). The figures are—

Area prescribed for clear felling (includes steep and unworkable ground).	Area felled.	Area regenerated.
Acres.	Acres.	Acres.
1,072	741	655

The species most in use are—

Buk (*Quercus lamellosa*) and other oaks, *champ* (*Michelia Champaca*), *pipli* (*Bucklandia populnea*), *Cryptomeria* and *utis* (*Alnus nepalensis*).

Results are good at lower elevations, but above 6,500 ft. the frost tender species such as *champ*, *pipli* and *utis* suffer from lack of shelter, and are held back even if not completely killed and the longer period taken to establish a canopy has resulted in deterioration of the soil in some places, especially where cultivation of field crops was allowed to go on after the first two years.

In the hills, complete fencing against game is not possible owing to the broken nature of the country. Fortunately the damage by game is not excessive in most places, and for species such as *champ* which are particularly susceptible to browsing it

has been found sufficient to protect each seedling by a circle of stakes. Even this amount of protection is only necessary where barking deer are specially abundant The total cost of plantations in the hills is therefore not enhanced by large sums spent on fencing, and amounts to approximately Rs. 8-8-0 per acre for formation (including cost of nurseries) and Rs. 3 per acre for tending for about five years following. The cost up to the time the plantation is established is thus Rs. 24 to Rs. 25 per acre only.

III.—GENERAL REMARKS.

Generally it will be seen that throughout North Bengal attempts at natural regeneration have been abandoned in favour of artificial regeneration and that the artificial regeneration is almost entirely by means of *taungya* cultivation.

The exceptions are—

1. Areas of riverain forest in the plains where *khair* (*Acacia Catechu*) and sissoo and a few other species regenerate themselves satisfactorily.

2. Areas of sal on the Bhabar and lower hills where there is still sufficient natural regeneration to justify a continuance of working on the selection system.

3. The practically unworked forests in inaccessible parts of the hills.

4. Areas in the plains worked for fuel and left to restock themselves by coppice and seed growth because labour for artificial regeneration is not available. In such places, cleanings to favour the more valuable species are made.

5. Very small areas where natural regeneration has appeared. These areas are most interesting—for example the Khariarbandar sal forest in Jalpaiguri division, which was "Protected Forest" until 1908, when it was reserved, appears to represent a survival of the conditions which prevailed over large areas of the reserves, some 30 years ago. Evergreen undergrowth is now slowly increasing, but there is still abundant regeneration of sal. The late appearance of evergreen undergrowth is probably due to grazing and ground fires during the protected period and

to the isolation of this small block of forest which is surrounded on all sides by cultivated lands. (A botanical survey would probably reveal the absence of several species of undergrowth and climbers which are common in the other sal forests in the district.)

Another example is an area of abandoned forest village land at Godamdabri (Buxa division). The adjoining forest contained some big *toon (Cedrela Toona)* and *simal (Bombax malabaricum)* trees and seedlings of these species came up in large numbers along with others of less value. Cleanings to favour the *toon* and *simul* were made and the crop is now complete and contains a large proportion of these. With a method which gives successful regeneration the question of regenerating the maximum prescribed area resolves itself into one of organisation and labour supply. It is of prime importance to get a complete young crop on the ground as early as possible, because success from the beginning means better results in the end and less ultimate cost The areas under regeneration and the fully stocked plantation which result from successful regeneration require constant skilled supervision and the amount that can be properly supervised by one officer is limited.

There are two ways in which the development of our organisation can proceed—one has been tried in Burma, *viz.*, the separation of regeneration work from other forest work with a separate staff for each branch. The other is the reduction in the size of charges (divisions and ranges) to bring the work within the scope of the officer in charge. It is in this second way that the organisation in Bengal is being very slowly adapted to present needs. Two of the most intensively worked ranges in the hills are only about 4,000 acres in extent—but even so they are as large as some European divisions.

We may be—and certainly hope that we are—working on the right lines, but we have a long way to go before our best working can compare with the standard set in European management.

A. K. GLASSON, I F.S

Deputy Conservator of Forests, Darjeeling.

NOTCHING OF GERMINATING TEAK SEEDS.

It is with some diffidence that one writes on the subject of teak since the feeling is always present that readers may have been practising for years any method of growing this species which one believes to be new.

Wherever this species has been raised artificially, no doubt, the relative advantages of direct sowing and planting have been ascertained by experiment. During recent years in Madras a good deal of experimenting has been done with stumps, or root and shoot cuttings. It is, however, to yet another method that this article is intended to draw attention.

In 1919 when the first regular teak plantation was raised at Mount Stuart in the South Coimbatore division small dumps of teak seed were put out in the plantation area and throughout the early part of the South-West Monsoon germinating seeds from these dumps were notched at stakes where seeds from the regular sowings failed to germinate. Since then it has become the practice at Mount Stuart, and perhaps elsewhere, to have these dumps, not only of teak but also of *Terminalia tomentosa,* scattered about the area under regeneration and it is estimated that about 70 per cent. of the saplings in the very successful teak plantations made at Mount Stuart in 1923 and 1924 originated from germinating seeds taken from dumps.

Dumps are made by upsetting one bag of teak seed on each acre to be planted 6—8 weeks before planting begins. No preparation of either the seed or the soil is essential but it is said to be a good thing to stand the bags of seed in cold water for, say, 24 hours before dumping.

Experience further indicates that it would be wise to dump two-thirds of the bag eight weeks before planting and the remaining one-third four weeks later, since germination in the first dump tends to be too far advanced when casualties amongst the first plants put out have to be replaced.

During the present year Mr. Connolly, the Madras Silviculturist, has raised a small experimental *taungya* plantation at Nilambur. In three plots, growing respectively rice, *ragi* and

dhall, he has introduced teak entirely by this method of notching in a sing e germinating seed at each stake at the beginning of the South-West Monsoon in June. Up to date the experiment promises to be very successful. The method is cheap and the percentage of fai ures from the original notching is reasonably low. It is, moreover, believed that potential plants, showing little or nothing more than two green cotyledons can stand a break in the monsoon rain better than transplanted seedlings can.

The method is infinitely more fool-proof than transplanting and has the advantage over ordinary sowing, in that it does away with the embarrassement of finding half a dozen seedlings appearing at one stake and none at all at the next. The initial work is easier to supervise and check than is the case with either ordinary planting or sowing. Length of transport from dump to stake is negligible and the risk of the minute radicles being damaged is less than that involved in moving plants with definite root systems and leaves.

Having shown that we can make a good job of this method in the case of teak, Mr. Connolly proposes to carry out a small series of experiments on the same lines with other species.

One object of this article is to invite readers to let us know whether the method has been tried elsewhere with species other than teak and, if so, with what results. A second object is to record the fact that the writer is now suggesting the method in several divisions as a possible way of reducing the cost of teak nursery work.

Where teak stumps are required the usual method of raising them appears to be to sow boardcast on seed beds and then to prick out the resulting seedlings into nursery beds at an espacement of about 6 × 6". This year the writer has seen numerous casualties amongst seedlings pricked out in this way and consequently he has suggested that transplanting might be done away with entirely if germinating teak seeds were notched directly into the nursery beds at the espacement

necessary for the production of well developed one year old plants.

A. WIMBUSH, I.F.S.,
Conservator of Forests,
III (W. P.) Circle, Madras.

[The above method has been used in the Gorakhpur division, U. P. for *Terminalia tomentosa* for the past two or three years.—ED.]

CONCLUSIONS BASED ON A GEOLOGICAL EXAMINATION OF TEAK BEARING ROCKS IN BURMA.

After a study of Burma rocks over a period of ten years I have arrived at certain conclusions which I give below. As there appears to be no literature on the subject I am wholly unable to say how far I am in agreement with other people's opinions. I have suspicious that some of my conclusions are at variance with established ideas. But I have studied my subject with an open mind for over a decade and I would ask indulgence for any seeming heresies.

To deal with all points enumerated would be rather a voluminous effort and I refrain from doing so for the moment as I should like to know just where I should have to explain myself most. In studying the geology of Burma I have followed Theobald.

CONCLUSIONS.

1. The finer soil of the older alluvium and the overlying regur-like deposits of the new are probably the original home of the teak. Most of the upper cultivated lands of the Sittang and Irrawaddy basins are of these formations.

2. If not eradicated by human agency teak exists to-day wherever these deposits occur.

3. Where these soils are deep the tree is large. Where shallow or with a hard-pan near the surface the trees are small but the teak is always there; it holds its own against all comers and tends to grow pure.

4. Wherever other soils approach the characteristics of the older alluvium teak is the dominant tree.

5. Teak being a shallow rooted species it needs moisture available near to the surface of the soil.

6. If the suitable soil is very shallow and its moisture content becomes too reduced by evaporation vigorous growth is checked and the teak stunts.

7. On the other hand if the soil is very free draining and very deep teak does not grow at all but other species come in.

8. If on such a soil water by any geological formation happens to be held near to the surface teak comes in vigorously and grows to a great size.

9. Certain sands, clays and other rocks disintegrate and form soils approaching the older alluvium. The teak grows large or small on such soils in accordance with what has been stated above and is always the dominant tree.

10. Teak can be traced through a forest simply by following such rock formations, usually but not always some form of sandstone.

11. Teak has established itself wherever conditions above mentioned exist. If any forest at the present day does not contain teak and, provided it has not been eradicated by human agency, it is almost certain that the geology of the locality is not suited to teak.

12. Changes in geology mean changes in species. As the geology has been changing through ages tree species have had to regulate themselves accordingly and, in these changes (which are gradual and run through thousands of years) all species have had an opportunity over and over again of coming on to their suitable soils.

13. In all soils formed from sedementary rocks (and this is more than 90 per cent. of Burma) it is the *physical* and *not* the *chemical* nature of soil which determines species.

14. This refers also to the immediate disintegration of most igneous and metamorphic rocks since the sedementary rocks are but derived from the igneous or metamorphic. But the igneous hold exceptions. The ultrabasic series of which a serpentine outbreak in the Arakan Yomas running through Thayetmyo Minbu, Pakôkku and probably through the Chin Hills into Assam is an example. Growth here is peculiar and characteristic.

15. In these conclusions nothing has been said about species other than teak, but it would be impossible to ignore them altogether when discussing this subject in detail.

16. Under conditions specified above teak germinates without difficulty and reproduces itself *in spite* of and *not owing to* ground fires.

17. In a teak bearing tract other species of trees or bamboos cannot be taken as infallible soil indicators of teak. Teak is its own indicator.

18 In process of geological change due to erosion or other causes large tracts of country may arrive at strata wholly unsuited to teak and the tree may then die out. Subsequently after further erosion suitable strata may reappear and no teak may be present to re-establish itself. This is a reasonable possibility and under such circumstances the absence of teak may be ascribed to heavy rainfal, which may have done nothing more than wash away altogether the once suitable rock.

19. Cretaceous rocks on the eastern slopes of the Arakan Yomas support very fine teak. Similar rock on the western slopes have no teak. There is a very big difference in the rainfall but, teak can stand 200 inches of rain and, teak clumps planted by dacoit villages to get the red dye from the young leaf some 50 or more years ago in the wilder parts of the Sandoway district are to-day holding their own. Judging by the eastern slopes of the Arakan Yomas the cretaceous limestone would be the best rock indicator of the locality in which to plant teak on the western slopes of these Yomas.

20 When calcium carbonate or calcium sulphate (gypsum) acting on stiff clays as a flocculator alters the soil into a marl

teak comes in but not in the dominant manner as on the older alluvium or similar loams On marls the teak, though growing magnificently, is in strong competition with *pyinkado* (*Xylia* sp), *taukkyan* (*Terminalia tomentosa*), *yon* (*Anogeissus* sp.) and other species which it does not meet on its native soil.

21. The term *rock* has been used geologically.

J. D. HAMILTON, I.F.S.

THE DAMPING OFF OF TREE SEEDLINGS.

A further contribution to our knowledge of this troublesome complaint in forest nurseries has been made by G Delevoy in a recent number of the Belgian Forest Society's bulletin.* He gives an account of his own experiments comparing and contrasting them with the latest published by Hartley† in America. The subject does not appear to have been studied to any extent in India but the loss from this cause is often considerable, as has recently been experienced in Dehra Dun with *Pinus longifolia* sowings, and has always been found in attempts to raise exotic pines, *e.g. Pinus insignis*, and many other kinds of trees. The form of damage is well known and is very like that caused by overheating of the surface of the soil It is also well established that the cause is the attacks of fungi such as species of *Pythium* and *Corticium* which are generally present in the soil as saprophytes and facultative parasites; ocassionally other fungi more definitely parasite (such as *Phoma* spp.) also participate. It has further been shown that these fungi occur as physiological races which vary in the conditions which permit of maximum development; that compost and similar manures favour their activities; and that tree species vary greatly in their liability to attack, pines being particularly sensitive.

A matter which still requires further investigation is the effect of dampness on the seedling mortality. There is a very general belief to which the usual name of the disease bears wit-

(*) Bulletin de la Société Centrale Forestière de Belgique 1926, pp. 306, 364

(†) U. S. Department of Agriculture Bulletin 934, 1921

ness, that stagnant warm and damp air increases damping off losses; this belief prevails in India But Hartley found that the damage occurred mostly in the daytime and less at night, whilst increased rainfall reduced mortality, and Delevoy finds that shading the beds is helpful. It is difficult to sort out the factors involved particulatly as between the initial attack (? dampness) and subsequent progress of the disease (? heat) and the general belief may yet prove well-founded.

Remedial measures tested go to show that dipping the seed in 5 per cent. potassium permanganate before sowing may help but that more can be effected by treatment of the soil and selecting a suitable seed covering. As regards the latter, Hartley recommends sterilised sand, Delevoy finds saw-dust twice as effective as sand, and Toumey* has obtained excellent results from soil dug up near the nursery from a depth of 2ft or more. A variety of organic and inorganic chemicals as well as live steam have been tried with the idea of sterilising the soil before sowing. Sulphuric acid can be quite effective but varies in its action with different soils and is safe only in skilled hands: moreover it is very liable to affect adversely the growth of the seedlings. Formalin in 1 to 5 per cent solution, and potassium permanganate or copper sulphate in 5 per cent. solution applied at a rate of about 5 grammes per square meter may according to Delevoy give five times as many survivals as the control plots: the first (and lysol also) must be applied a few days before the sowings. On the other hand Toumey† found that formalin was of very little use especially owing to its action in reducing germination.

If the damping off is in progress, not much can be done, but a 1 per cent. permanganate solution gave fair results—prevention in this case is more than ever better than cure.

The value of charcoal as a preventive has been suggested ‡ but was not tried in this series of experiments.

The general impression obtained from a perusal of the literature on the subject is that the results obtained with the

* Seeding and Planting, 1916 p. 357.

† Yale University, School of Forestry Bulletin No. 1921

‡ Forestry Quarterly XIII, 1915 p. 25

several reagents depend so largely on the many variable factors such as soil, weather, species and details of treatment, that it is unsafe to make any generalisations particularly for the cases in which we are likely to be most interested in India, *i.e.* the small scale nursery and the raising of small samples of seedlings. At the same time, the sulphuric acid treatment appears certainly the most promising under average conditions.

H. G. C.

EXTRACTS.

THE IMPERIAL CONFERENCE, FORESTRY REPORT.

The following report of the Forestry Sub Committee, which was set up in pursuance of a decision taken at the opening meeting of the Imperial Conference on October 19th, 1926, to consider Empire forestry questions, was issued yesterday. The Sub-Committee was constituted as follows :—

Great Britain.—Lord Lovat, Chairman Forestry Commission (Chairman); Sir J. Stirling-Maxwell, Empire Forestry Association; Mr. R. L. Robinson, Forestry Commission; Professor R. S. Troup, Imperial Forestry Institute; Mr. M. F. Headlam, Treasury. Mr. J. E. Stephenson, Dominions Office; Mr. R. S.

Pearson, Department of Scientific and Industrial Research; Lieutenant-General Sir William Furse, Director, Imperial Institute and Sir R. Greig, Scottish Board of Agriculture.

Commonwealth of Australia.—Mr. H. W. Gepp, Chairman, Development and Migration Commission, and Mr. F. C. Faraker, Office of High Commissioner.

Union of South Africa.—Mr. Havenga, Minister of Finance, and Dr. A. J. Bruwer, Chairman, Board of Trade and Industries, Department of Mines and Industries.

Newfoundland.—Mr. Monroe, Prime Minister.

Colonies and Protectorates. Mr. O. G. R. Williams, Colonial Office.

Canada.—Dr. J. H. Grisdale, Deputy Minister for Agriculture.

New Zealand.—Sir Francis Bell, Minister without Portfolio.

Irish Free State.—Mr. A. C. Forbes, Director of Forestry, Department of Lands and Agriculture.

India.—Sir Peter Clutterbuck.

Mr. Fraser Story, Forestry Commission, and Mr. T. J. Kiernan, Irish Free State, were appointed as joint secretaries to the Sub-Committee.

Text of the Report.

The Sub-Committee have had under consideration a number of subjects on which they have received detailed reports by competent authorities (copies of which are appended to the report). They desire to draw particular attention to the following Imperial aspects of forestry:—

World's Timber Supplies in Relation to Forest Policy.—The outlook with regard to the world's supply of softwoods, which constitute about 80 per cent. of the wood used for industrial purposes, is distinctly unsatisfactory. The outlook with regard to the hardwoods of temperate countries is also unsatisfactory, but it will no doubt be possible to supplement the supply to some extent by having recourse to tropical hardwoods. There are, however, difficulties of various kinds in the way of replacement of temperate by tropical hardwoods.

Apart from the question of the availability of supplies of softwoods and hardwoods in sufficient quantities to meet demands, there are very important internal questions, both social and economic, which point to the necessity of all countries maintaining and extending, where possible, their existing forest areas under a system of management based on sustained production of timber.

The Sub-Committee believe that there are few subjects concerning the general well-being of individual parts of the Empire as a whole, which require more earnest consideration by statesmen than this subject of the rational use and development of forests.

The Empire Forestry Conference to be held in Australia and New Zealand in 1928.—The Sub-Committee have considered and commend for approval the preliminary arrangements for the work of the Empire Forestry Conference to be held in Australia and New Zealand in 1928. They have also made suggestions, which the Standing Committee on Empire Forestry will take up, as to the specialists who should be delegated to attend the Conference in order to render it thoroughly effective. They desire to urge the importance of every part of the Empire making adequate preparations for the Forestry Conference and being suitably represented.

Empire Settlement.—The Sub-Committee consider that there is a distinct possibility of developing schemes of settlement in connexion with State forestry and afforestation, or of developing adequate afforestation schemes in existing agricultural areas. The experience gained by the Forestry Commissioners in Great Britain should be of use in this connexion. The Sub-Committee are in agreement with the views expressed in the memorandum on the subject of State Forestry in relation to Land Settlement which forms Appendix III to the report, and have communicated it to the Sub-Committee of the Imperial Conference on Overseas Settlement.

Imperial Forestry Bureau.—The Sub-Committee are of opinion that there is a useful purpose to be served by an Imperial Forestry Bureau to act as a clearing-house for information; and

that the matter in all its aspects should be referred to the Empire Forestry Conference, 1928, for consideration and report.

Forest Products Research.—Since the first Empire Forestry Conference of 1920 considerable progress has been made in the number and capacity of the organizations for forest products research in the Empire, but there appears to be much need for further work and for co-operation between the various organizations. This subject will receive special consideration at the Empire Forestry Conference of 1928.

Imperial Forestry Institute.—The Sub-Committee are impressed by the useful work which has already been done at the Imperial Forestry Institute at Oxford. They particularly desire to draw attention to the opportunities which are afforded to foresters from overseas to study in and from this Institute the results of long-established scientific management in European forests.

Empire Forestry Association.—The Sub-Committee recognize the good work being done by this Association, which forms a useful link between the various forest services of the Empire and provides in its Journal a means of disseminating technical forestry information.

Proposed Resolution by the Imperial Conference.—The Forestry Sub-Committee, therefore, recommends that the Imperial Conference should adopt a resolution on the following lines :—

"The Conference, appreciating the importance of forestry to the Empire as a whole and to its constituent parts.

(*a*) Takes favourable note of recent developments of effective organization within the Empire as exemplified by the Standing Committee on Empire Forestry, the Imperial Forestry Institute, and the Empire Forestry Association, and draws special attention to the need for co-operation in all lines of forest research;

(*b*) Welcomes the invitation of the Governments of Australia and New Zealand to hold the third Empire Forestry Conference in those Dominions in 1928, and recommends to the Governments of the various parts of the Empire active preparation for and participation in that Conference; and, further, notes with appreciation the invitation by the Government of the Union of South

Africa for the Empire Forestry Conference of 1933 to be held in that Dominion.

(*c*) Refers the important question of constituting an Empire Forestry Bureau to the Empire Forestry Conference of 1928."

Six appendices are published with the report. The first is a Note by Mr. Fraser Story, of the Forestry Commission of Great Britain, on the world's timber position, giving the distribution of forests and the timber requirements of the world. The preliminary agenda and the arrangements for the Australian-New Zealand Empire Forestry Conference of 1928 are set out in the second appendix; the third consists of a Memorandum on State Forestry in relation to Land Settlement, by Mr. H. W. Gepp, Chairman of the Development and Migration Commission, Australia, and Mr. R. L. Robinson, of the Forestry Commission of Great Britain; a Memorandum on Forest Products Research within the Empire, by Mr. R. S. Pearson, of the Department of Scientific and Industrial Research, forms Appendix IV; Appendix V is a Note on the Imperial Forestry Institute, University of Oxford, by Professor R. S. Troup, and Appendix VI, a Note on the Empire Forestry Association, 1926, by Sir John Stirling-Maxwell, Chairman of the Association.—(*The Times, 19th November* 1926.)

THE HARDWOOD MARKET IN BRITAIN

Extract from a lecture by Leslie S. Wood, F.S.I., before the Timber Trade Federation:—

The hardwood market of to day and in the future is mostly concerned with oak, ash, elm and beech, and, as these form the bulk of the hardwood trade, it is well to study them and know something of their history. It is a little obscure, but planting work in the past had its periods just as we can say that the Japanese larch and Douglas fir period commenced twenty years ago, and merely constituted a new period in the growth of conifers. Of the four trees mentioned the oak takes precedence. It takes precedence to-day because it forms a larger part of the home-grown timber merchants' trade than any other tree, and because it has a larger number of uses. It was far more prominent at the begin-

ning of the nineteenth century, when it was essential for shipbuilding, upon which the safety of the trade of this country depended.

In the early days before the opening of the nineteenth century, oak was grown in mixture with other trees, more particularly with beech, and occasionally with chestnut, and possibly there were conifers mixed with them, but the essential point to be remembered is that up to the year 1800 oak was grown with beech and produced the wonderful timber that we still find in this country, but which is rapidly disappearing. This timber is usually long and clean and, by reason of the method of growth the trees are usually full of vitality and would stand for many more years, if necessary. At the same time, the quantity is becoming very limited and, if there were a trade boom and a demand for it, it would rapidly disappear, except so far as owners of estates reserve it for ornamental purposes.

About the year 1800, in the days of Nelson, the nation seemed to be anxious about the supply of oak, and a large quantity was planted in the Government woods and on private estates, but for some reason, which we cannot explain, the old system of growing with beech was abandoned, and the trees were planted pure. The result was a failure. We may judge from what we know to-day and from the subsequent work that the oaks so planted were very slow to grow, and after the next ten years or so the system of pure oak plantations was abandoned. Twenty years ago large areas of these oaks could still be seen in the Forest of Dean and the New Forest and in certain private estates, but very many have now been removed. They were mostly short boled with large heads, and of an inferior type.

We know that it is very difficult to get oaks to start when planted pure, and it is probably for that reason that, when the system was abandoned, the planters of the next decade mixed the oaks with Scots fir. This system, as a whole, was no more successful than the previous one. There were certain areas where the soil favoured the oak more than the Scots fir, and the former made good, but in the majority of cases the conifers outgrew the hardwoods, and the oaks were a failure. In pre-War

days there were considerable areas where one could see the result of this planting, where in patches the Scots fir or the oak survived according to the suitability of the soil, and where the trees were intermixed because the soil gave them both an even chance. Most of the Scots fir of these areas was cut out during the War, and the inferior oaks were left to form waste or unremunerative areas. As soon as it became apparent that the oak and Scots fir mixture was not a success it was abandoned. The first effort had shown that some tree as a nurse was necessary, the second effort showed that some less vigorous tree was essential, and for this reason the larch took the place of Scots fir. The new mixture, which came into favour between 1820 and 1830, was in a large measure a success, its lighter foliage and straighter growth gave the oak more scope, and the result was that many of these plantations survived, and, if we go back into the history of many of the pure oak woods that we see to-day, we find that the trees were originally drawn up with larch, which have since been removed. These oaks are long and clean, but as we find them, they only average about 25 to 30 feet per tree, and as a rule make very little growth.

There is considerable difference between the vigour of the oaks that have been grown up with beech and those that have been drawn up with Scots fir or larch. The former are still full of life, and the latter give the impression that they have come to the end of their time. There is no question that the leaf mould from the beech is a great help in the maintenance of other trees, and this partly accounts for the lack of vigour of the latter class; but, apart from that, we may well understand that, when the oaks are pushed up rapidly by fast growing conifers in the struggle for light, this weakens their constitution, and, if their heads are compressed by the conifers around them, they cannot expand, and have insufficient leaf surface to carry on the process of development Whatever the cause may be, it is very noticeable that oaks of this period do not last, and they invariably form a very unprofitable crop, and should be cut. For some reason, either due to the repeated attacks of the oak leaf roller caterpillar or to the dry season of 1921, a very large number of oaks have died or become stag-headed in the southern counties in the

past two years, and it is noticeable that oaks that have been drawn up in plantations without beech have invariably suffered heavily.

There is one other class of oak of which mention must be made, and that is the coppice oak. This is grown with an undergrowth of hazel, hornbeam, ash, chestnut, or occasionally some other variety, and the soil conditions are favourable for the growth of good timber; but, until the last 30 years, the underwood was considered as the main crop and timber as a subsidiary, and consequently, we seldom get first class timber in these coppices. It was customary to speak of "setting out" the timber, an expression which is still used, and it meant in effect, that the trees were set out too wide apart to be drawn up, and, consequently, those that we find to-day are mostly short in the stem with wide heads ranking only as second or even third class timber.

Looking back on this historical review, what do we see? In the first place, *practically all the first class oak belongs* to a period prior to the beginning of the eighteenth century; it is mostly between 130 to 200 years old as a business proposition it is unprofitable to the owner because of its slow rate of growth; it is not unreasonable to suppose that all that can be treated commercially will be cut in the course of the next twenty years. The timber grown with conifers now averages about 110 years. It was planted to be treated as a crop and cut when mature, and most of it has not only reached that stage, but is depreciating and should be felled. Not much of the oak that was planted pure remains so. It is not unreasonable to assume that at the end of another 20 years, timber merchants will be largely dependent on hedgegrows and coppice grown timber for their supplies. Very little of this will be of first class quality, and, as the planting of oak had practically ceased by the middle of the nineteenth century there is little prospect of any supplies of first class oak in this country within the lives of any of us.

The ash market is very different. If we should be disposed to think that, after all, there must be plenty of oak and we need not worry, we should remember that 20 years ago no one anti-

cipated a shortage of ash, but the War and the demand for British ash for sports purposes have made such demands upon the supply that British grown ash suitable for sports purposes is becoming very scarce. Ash has commanded a fairly good price for some years, it grows quickly, and is marketable at 40 years or possibly earlier, and consequently, owners have been more disposed to plant it. There will always be a small supply coming to maturity, but the demand is in excess of the annual growth to-day.—(*Timber Trades Journal, Vol. C, No* 2615).

[Nothing could better illustrate than the above article, the folly of not employing competent experts in their own profession. The above facts concerning oak are no new discoveries but are well known to professional foresters. They were equally well known 50 if not 100 years ago and most of these deplorable mistakes could and would have been avoided by trained men.—Ed.]

ZOOLOGICAL GARDENS CONFERENCE

THE EUROPEAN BISON.

The annual conference of the Directors of 16 European Zoological Gardens, including these of Basel Rotterdam, and Vienna, will meet at Vienna from August 30th to September 2nd. The object of these gatherings is the exchange of experiences since the last congress in various realms such as the better housing of animals in the various seasons, the fight against rats and other plagues of Zoological Gardens, the exchange of animals, and the like.

Another congress announced to be held in Vienna from September 2nd to 4th is that of the International Society for the Preservation of Wisent or European bison, of which the Duke of Bedford is the president.

In conversation with the Austrian Secretary of the Society Dr. Antonius, I learn that there are altogether 66 specimens of this animal known to be alive to-day, 33 bulls and 33 cows. The Vienna Zoological Gardens boast four fine specimens, all born at Schönbrun, the last of them seven months ago Others

are scattered up and down Europe, while the Duke of Bedford owns several head. The efforts of the Society are bent upon increasing the existing stocks to prevent the total extinction of the animal. The Society was formed three years ago and has already succeeded in increasing the stocks by six. Whereas only three years ago a couple of wisents were on the market for £40, a bull in the following year fetched £300; last year it could not be purchased for less than £600, while the only animal offered this year was priced at £1,000 The nominal price of a cow this year is £2,000.—(*The Times.*)

FORESTRY IN SPAIN.

A Royal decree published in the *Gazette*, outlines the interesting proposals made by the Ministry of Public Works for extensive reafforestation in Spain. New nurseries are to be planted by the State, and owners of uncultivated land will be encouraged by credits and other facilities to plant all waste ground. In the case of refusal the State will rent the land from the owner and will proceed with reafforestation work as rapidly as possible.—(*The Times.*)

HARDWOOD INDUSTRY IN ONTARIO.

An agreement between the Ontario Government and a group of American capitalists has been completed by which a hardwood industry will be established in Northern Ontario between Brucemines and Thessalon which will employ 1,000 men. One million dollars [£200,000] is to be spent in the construction of saw mills, flooring plants, veneer plants, and other woodworking industries. The company will secure cutting rights to hardwood timber in 25 northern townships.—(*The Times*)

MATCH INDUSTRY IN BENGAL DURING 1925.

The following is an extract from the Annual Administration Report of the Department of Industries, Bengal, for the year 1925:—

A number of large and up-to-date match factories have been established in and near Calcutta, eight in all, and the approxi-

mate output of these factories will be of the order of 13,000 gross boxes of matches per diem. The smaller match factories using hand machines have either ceased to exist or are in a moribund condition. It appears that the cottage system for the manufacture of matches will not be able to hold its own and face competition with the modern factories using up-to-date power-driven machinery. As many operations are involved in the production of finished matches and as the products are of comparatively small value, it is unlikely that the manufacture of matches on the cottage system will be successful

Though many species of wood in the Bengal forests have been found suitable for the manufacture of first class safety matches as a result of the investigations carried out by this Department, little advance has been made in the utilization of these species chiefly on account of the scattered occurrence of these woods and also on account of the unfavourable railway rates.

Most of the factories are using imported logs chiefly from Sweden and Siberia though some of the factories are trying to use *gangwa (Excæcaria Agallocha)* wood which occurs plentifully in the Sunderbans and which can be brought to Calcutta by means of country boats at a reasonable cost. The available supply of *gangwa* wood is, however, not inexhausatible and until systematic cultivation is taken up there can be no security for continuity in this direction. Successful experiments have been carried out by the Industrial Chemist to bleach splints manufactured from *gangwa* wood. Though first class splints comparable to the splints made from imported wood could not be produced, nevertheless it has been demonstrated that matches of good quality can be made from this wood. Schemes have been prepared by this Department for different sized match factories, and the conditions, both economic and technical, have been analysed for the benefits of the persons interested in this industry. The Chemical composition of matches and the conditions governing the production of damp-proof matches have been studied by the Industrial Chemist with the help of power driven laboratory machines. First class compositions for match

heads have been prepared, and further experiments are now being conducted to ensure the comp.ete success of this industry in Bengal. In conclusion, it can be said that the match industry, in spite of many difficulties, is on the way to success and the factories so far established or contemplated in Benga. are sufficient to meet all her requirements.—(*Timber Trades Journal.*)

DEFECTS AND DISEASES OF TIMBER TREES.

An interesting lecture was delivered by Mr. Alfred Carr, at the Geffrye Museum, Kingsland Road, Shoreditch, London, E., on "Growth, Structure, Defects and Diseases of Timber Trees." The lecture was illustrated by some 72 lantern sides.

Having briefly described the growth and structure of a tree stem, Mr. Carr dealt with the defects and diseases that trees and timber are liable to. First, he took heart shake, which are clefts crossing the heart—wider in the centre—caused by shrinkage of earlier formed wood. A.l trees were liable to it, Indian teak most, and African teak least. Then there was star shake, clefts starting on the outside of the wood, narrowing as they entered, common in thin-barked trees caused by frost bursting the cells, or the sun drying them up, thus causing a line of cleavage which subsequent shrinkage enlarges. It was also caused in logs, not cut, by shrinkage alone. Then there was cup shake, separation of the annual rings, common in heavytopped trees, such as pine. This was caused through swaying in a wind, or any sudden artificial check to growth. Local cup shakes, caused by damage to the cambium layer, healed over and were ca.led "rind galls." These shakes caused the defect known as "riftiness." Then, fina.ly, there were upsets or thunder shakes, which might be caused by the tree being badly shaken and bent in a strong wind, or the vibration of the tree in a tornado; a bad fall when being felled, or transported, which snapped the dry wood inside. Rapid growing trees were liable to it, especially large Honduras or Mexican mahogany.

Knots, said Mr. Carr, were not always a defect, and the simplest way of describing them was to say they were branches persisting through the stem. The most common of all the diseases of timber, however, was fung is. When at Buckhurst Hill, he noticed a tree fallen down, and he counted no less than thirteen different fungi on it. The fungus was living on the wood, and ruining the tree absolutely. A book had recently been published which gave the names of 8,000 fungi, but he did not intend to deal with all of them. Scaly fungus was mainly confined to the ash tree and shell fungus to the birch. There was one known as the "beef steak" fungus, which was edible. Sulphur tuft was a common fungi which could be found on the elm. This name "sulphur" soon became obvious as to its origin when one struck it with a stick. The smell was absolutely like sulphur.

Wet rot, continued the lecturer, was where bacteria was carried in water into the wood through a wound causing a fermentation which rendered it very liable to attacks of higher types of fungi. Bacteria action was seen in a freshly cut board of pine when the sapwood turned blue few hours after being cut. Dry rot was a fungus which attacked wood placed in badly ventilated positions. This disease was contagious, and if a piece of timber which is diseased was nailed to another which is not, it would spread very shortly. This is one of the worst diseases for timber in the house.

The action of the visible fungi was peculiar, continued Mr. Carr. The fungi spores blow about in the air and settle in a cleft in the bark, or an open wound, germinate, and penetrate the tissues, set up a fermentation, and consume the cell contents. then it would break down the cell walls and disintegrate the wood, reducing it to the condition of "touchwood." "Leaf galls" was a disease that affected the growing trees, comparable to cancer in animals. Various gall flies punctured the leaves and twigs, laid their eggs in the wound, and a malformation of growth was caused, visible as oak apples, bullet galls, etc., all robbing the plant of its store of food. Wood worms, the larva of various moths and beetles attacked both the standing tree and converted timber. The goat moth, which grew as large as a man's middle finger, a common

infestor of poplars and limes, and the grubs of tick beetle, which caused so much damage to oak roofs, were two common kinds. The termite was a tropical white ant, which was a most deadly foe to many kinds of wood. In Africa, if a house was built and the intending occupier left it for a week, when he came back to see if it was still all right, he would be surprised when he opened the door to see his wooden house collapse. Teak was immune to their attacks which was the reason why a large quantity of tropical furniture was made in teak. Teak was also unaffected by the teredo or ship worm, which was a great enemy to timber in tropical seas, and in the days of wooden ships, they were sheathed in copper below the water line as a protection against these pests.

The *lomnoria* was a species of water wood louse, which existed in great numbers in the rivers, and estuaries of England and temperate countries generally, and caused great destruction of wharf planking, lock gates, weir piles, etc. Old Southend Pier was affected by this species, but it was not discovered until a vessel collided with it, so showing where they had been at work. The burr was an abnormal growth on some trees, which in most cases enhanced the value of the wood. Ivy, which every body must have seen, mostly wound itself round smooth barked trees and strangled them.

The lecturer was heartily thanked for his interesting lecture.

(*Timber Trades Journal.*)

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HOW THE TEAK POLE FORESTS OF THANA ARE REGENERATED.

There is little that can be called new about this system, but it may be interesting to know how the Thana Forests of Bombay are faring under it, the progress that has been made since its introduction ten years ago and what the prospects of the future crop are like.

The area is nearly 1,000 square miles of forest situated on the Western Ghats and the broken hilly country between them and the sea, with a rainfall of roughly 100 inches.

These have been called teak pole forests for convenience. In reality they are mixed deciduous, teak varying from 5 to well over 50 per cent and averaging 25 per cent. *Terminalia tomentosa* is almost as plentiful; other good junglewoods are *Acacia Catechu*, *Dalbergia latifolia*, *Pterocarpus Marsupium*, *Adina cordifolia* and *Anogeissus latifolia*, forming together perhaps 20 per cent., the remaining 30 per cent. being about half fit for fuel and charcoal and half more or less useless at present.

The wealth of these forests lies in the large teak poles, the average ranging from 3 to 4 feet girth, though 5 foot trees are not uncommon in the best forests: also in the reasonable accessibility to railways and bunders which makes charcoal and fuel marketable. The forests since 1917 have been all worked by clear felling. The rotation is 80 years for all except the poorer areas, for which it is 40 years The coupes, which are invariably sold standing, fetched Rs. 12,75,151 or Rs. 165 per acre in 1920-21, and after the period of depression following the post-war boom, are gradually working back towards that figure. The best coupes have occasionally fetched as much as Rs. 1,000 per acre. These

forests are, therefore, among the richest revenue producers in India and their regeneration is a matter of first importance.

Teak coppices vigorously in Thana. The working plan figures show approximately the following :—

Years	5	10	15	20	25
Current 5-yearly girth increment (inches).	6	$3\frac{3}{8}$	3	3	$2\frac{5}{8}$

But this average has certainly been exceeded since clear-felling took the place of coppice with standards —a very heavy reservation of these. In good localities it is not uncommon to find dominant shoots with 18" girth and 30 feet height after nine years. A very fair amount of regeneration is thus obtained by coppice alone, and the artificial sowings which are the subject of this note were at first largely supplementary. During these first ten years of the working plan period, however, they have been so persistently developed that in all cut coupes where they have been successful the teak of the next crop should consist mainly of seedling trees.

The method followed is known locally as sowing on *rab* patches. *Rab* is the use of wood ash manure for preparing seed beds for the Thana ricefields, and its application to the cultivation of teak in forests is easily grasped by the local workman. The coupe contractor is bound by his agreement to spread material under 6 girth, and all wastewood, in patches at fairly regular intervals These patches cover from a few square yards up to nearly one-fourth acre in rare cases. The tendency is to insist gradually on larger patches as they are more economical to weed later on. Roughly they may average 30 feet square or in diameter.

The number and size of patches depend on the amount of loppings and wastewood available. Near big villages it is hard to get enough as the people have the privilege of removing small wood while the contractor's charcoal-burners make further inroads on the supply. The number varies from 3 or 4 up to nearly 30 patches per acre, and they are supplemented by the burnt sites of charcoal kilns.

The *rab* patches are burnt as early as the coupe work will allow, generally in April. They and the charcoal sites are dibbled all over with teak seeds in May, 2 or 3 seeds together, the dibblings being seldom over 3 feet apart and generally closer. By now it is fairly well established that the best germination is got from large new seeds which have been alternately soaked and exposed to the sun for 14 days, the whole process being done thrice over.

The rain begins normally from 10th to 15th June and when things go satisfactorily the patches are well covered with small seedlings by late June or early July. Things have a way of going wrong, however. The seed may be poor, the *rabs* may be burnt or the seed put in too late, or a long break in the rain may kill the seedlings off. At any rate all patches not reasonably well stocked by mid-July are filled up with seedlings from neighbouring protected forest or occupied upland. It sometimes happens that even a second planting up of failures is necessary. A good ranger or forester really intent on the work seldom fails to have at least 75 per cent of his coupe patches well stocked with seedlings and plants.

The first weeding begins in late July and extends well into August; the second in October, extending far into the dry season as labour is hard to come by at that time. Often a first weeding round the seedlings is done when the supplementary plants are put in, and by the time this is completed it is time to weed the whole area again. Thus there may be three weedings in the first rains.

Besides a very rank growth of grass the cut coupes of Thana are infested with the creeper *Mucuna pruriens*. Unless this is cut away early it forms dense heavy masses which spread themselves like a close net all over a patch and may squash down and stifle every plant in it. This creeper is perhaps worst in the second year and if plants come through that by a second year's weeding they can cope with the rapidly diminishing vigour of this pest.

Two weedings are required in the second year and are exceedingly important, and again some weeding in the third year. Then the coupe is left till its 5th year, in which a regular "cleaning" takes place. This is chiefly for removal of fast growing

species which are either dominating the patches or threaten to do so before the 15th year, when the first thinning is due to take place.

The following figures of cost per acre are taken from an inland range in the Dahanu Taluka :—

			Rs.	a.
Burning patches	..	...	0	8
Collection and dibbling seed	...	...	1	0
Filling up with transplants	...	...	1	4
1st weeding	...	...	0	12
2nd ,,	...	..	0	12
Mulching (only of weakly specimens)		.	0	2
1st weeding in 2nd year	...	...	1	0
2nd do. ...	...	..	0	14
3rd year weeding ...	...	...	0	12
Cleaning in 5th year	...	...	0	8
	Total		7	8

These figures are for regular employment of coolies on daily muster-roll. In many ranges a good deal of the work is paid for by lump sums, which keeps the expenditure down below Rs. 5 per acre. In many localities labour to carry out all the necessary work is not available and the total expenditure over the three Thana divisions falls far short of what it ought to be.

The crop of teak seedlings and plants thus raised in scattered patches throughout the coupes have a host of enemies to contend with before they are thoroughly well established The overmastering growth of softwood species, grass and creepers, has already been referred to. Rats and hares do immense damage sometimes destroying more than half the seedlings in a coupe. Painting the stems with phenyl has been tried, with little success . stones placed round the seedlings are considered to give a measure of protection but in dealing with so extensive areas the best hope lies in having many and vigorous plants. It is a firm belief with the subordinates that a pile of whitewashed stones in a regeneration patch frightens off hares on moonlight nights when their depredations are most active.

Cattle trespass does a certain amount of harm and much more is done by villagers coming in and breaking down stems to strip the leaves for thatching. This is one of the worst forms of damage because it is practised on the best-grown saplings which have come through the initial dangers.

Fires are very destructive and stems once burnt back are handicapped in the struggle with surrounding growth and usually produce several weak and twisted shoots. Cutting these back has not so far produced much good. For four out of the ten years this regeneration system has been running, early burning of closed coupes was tried, both to mitigate the effect of later fires and to drive away rats and hares. After a thorough trial it has been absolutely given up. It was found impossible to hit off the right time for burning when so many and varied coupes were concerned. Grassy meadows and uplands burned like furnaces killing or injuring every plant even in weeded patches, while creeper tangled slopes where fire might have done good were left unburnt. In the older coupes it was impossible to weed the plants in time to protect them from the fire. Altogether a big total of damage was done before the experiment was abandoned.

On the poorer dry soils near the coast, where the people remove most of the loppings, and in the dry uplands of the east part of the district it has been found so far difficult to get seedlings and plants of sufficient vigour to cope with all the difficulties described above. More than all the want of interest and energy on the part of subordinates in tending the saplings through their second and third years has led to a lot of good initial work being spoiled.

With all these difficulties and drawbacks the work has improved enormously of late years while in some parts it has been consistently good from the start. There is probably no other forest work where the individuality of the Ranger and Forester counts for so much, and the efforts of the better men have attained fine results and are worthy of the highest praise.

The coupes (they average about 50 acres) in the best localities and where good men have been in charge, show in the first

season after cutting from 50 to 80 thousand plants, in some 1,000 patches of 50 to 80 plants each. These may average a foot in height but generally some 15 per cent. will be found from 3 to 6 ft. They preserve their dark green leaves throughout the dry season. In the second year where well weeded they may be anything up to 15 ft. height and 6 inches girth, but the average is more like 6 ft. and 3 inches. In coupes after the 5th year cleaning, saplings and young poles are found in clumps up to 22 ft. height and 11 inches girth, the average of unsuppressed stems being perhaps 12 ft. and 6 inches. More average coupes start with anything from 30 to 50 thousand plants, while poor soil coupes and those where the work has been scamped may show only 2 or 3 thousand by the end of their second dry season.

Though the financial results of this work by the end of the 80-year rotation are difficult to prophesy there can be little doubt that the presence of these groups of teak seedling trees well distributed over the area will enormously enhance the prices of the coupes at the next time of selling. The first thinning is prescribed after 15 years and even that must produce some saleable small rafters. Later thinnings are not yet prescribed but there will be certainly two more perhaps at 30 and 60 years, when a substantial intermediate yield may be expected.

The following two coupes, with respectively 75,000 and 15,000 plants to start with, may be expected to give something like the net financial results per acre from cultural works estimated below :—

(1) 1,500 Trees per acre.

					Net profit Rs.
Cost Rs. 7-8-0 ...	One third may reach 15 year thinning		500		
	Removed in thinning	...	300		
	Of which 100 may			sell for Rs. 50	
Capitalised @ 5 per cent = Rs 15.	Leaving	.	200		
				— 15	35
	At 30 years, removed	...	100	@ Rs. 2-8-0	250
	Leaving ..	..	100		
	At 60 years, removed	..	40	@ ,, 7-8-0	300
	At 80 years ..	..	60	30 @ ,, 15	450
				30 @ ,, 20	600
				Total Rs. ..	1,635

(2) 300 Trees per acre.

	Left at 15 years ...	... 100		
	Removed	... 60		
	Of which 20 may		sell for Rs. 5	
	Leaving ...	. 40		
Cost at 15 years	.. ...	..	Rs. 15	− 10
	Removed at 30 years	... 20	@ 2-8-0 = 50	
	Leaving ...	.. 20		
Remaining capitalised cost.	.	..	20	30
	Removed at 60 years 5	.	@ 7-8-0	37-8
	At 80 years ..	...	{ 10 @ Rs. 15-0-0	150
			{ 5 @ „ 20-0-0	100
			Total Rs. ..	307-8

Besides this there will of course be the teak coppice and the junglewoods, both in the intermediate and final yields. These figures may be too hopeful but there is nothing fantastic about them. They show that where there is a large stock of seedlings and plants to start with it will pay to spend quite a lot of money to see them thoroughly established, and that generally speaking the regeneration of the Thana forests promises to be a highly paying investment.

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FOREST ADMINISTRATION.

(Lecture given to the senior students of the Rangoon University, by H. W. A. Watson, Chief Conservator of Forests, Burma.)

Introduction.—Few of us realize the extent to which we depend on the forests for most of what we consider necessities. The possibilities of manufacture from the raw materials yielded by the forest are unlimited. They are the basis of most of our implements of work and play—our books, our newspapers, our tennis racquets, our gramophone records—and of materials ranging from artificial silk to explosives, from perfumes to alcohol. The products of the forest have been the earliest materials used by mankind and their importance in human life has increased rather than diminished with each stage of progress from a primitive state. Everywhere the progress of material civilization has

been characterised by steadily increasing demands for timber and the products of the forest. Timber with its special combination of strength, rigidity and elasticity as compared to its weight holds a unique position as a material for use from which it is never likely to be displaced. Timber is as essential to trade and industry now as it was thousands of years ago when the first boats were hollowed out from tree stems. No mining can be carried out without timber for props and scaffolding and no buildings can be built without the aid of timber to raise the materials into position.

The increased demands for timber have been accompanied by an expansion of human activities in other directions. This expansion has led everywhere to clearance of forest land and this clearance has led to an ever increasing difficulty in obtaining supplies of forest products. The story is much the same in each country. People began by assuming that the supplies from the forests were inexhaustible and were gradually forced by increasing difficulty in obtaining them to introduce legislation for the protection of their forests and finally to take steps to administer them. At present all civilised countries recognise that forests are essential for the national welfare and are devoting increased attention to their protection and management. In some cases the recognition is too late. The forests have been destroyed by unregulated and wasteful use. As a result expensive operations have to be undertaken to replace them and the country concerned has to buy its requirements from another at great cost. There is at present a shortage in world supplies of timber and the country that has fostered its resources is in a very fortunate position.

Forestry is essentially a matter for control and development by the State. It cannot be left to private enterprise. There must be continuity of management as forest crops take a long time to mature and a broad policy which considers not only the profits to be derived by the management but also the welfare of the community as a whole. There is no guarantee of continuity of management when land is privately owned and the objects of a private proprietor generally centre in the realisation of the greatest profit. The State on the other hand can guarantee continuity of

management and can afford to subordinate purely financial interests to the welfare of the community.

The system of management to be applied to State forests should be that which secures to the country the greatest possible advantage whether it be represented by high financial returns or by other important considerations.

The position which forests occupy in the economy of Burma is so very obvious that it is hardly necessary to touch on it. Outside the towns all the houses are built of wood or bamboos. In many cases no nails are used in their construction. Many of the jungle people draw their whole sustenance from the forests. They depend on the ashes of the trees to manure their crops and they depend on the products of the forests to house them. Last but not least the country as a whole derives a substantial net revenue from forest management which is available either for public works or to lighten taxation in other directions. This net revenue has averaged more than a crore of rupees annually during the past seven years.

Before touching on forest administration it is necessary to emphasize the fact that a forest is a living thing. Under care and treatment it increases in value. Uncared for or maltreated it deteriorates or may even be killed. Each year a forest puts on new growth or increment and we can take the quantity represented by this new growth without harming the forest or reducing its capital value. Under proper management therefore a forest can be worked for hundreds or even thousands of years and still be as good as ever. In fact it should improve under the management because study and experience would improve the method of treatment and thereby increase the productive power. In its capacity for growth a forest differs from a mine which is incapable of growth and however rich it may appear is only capable of yielding a definite quantity which can be calculated.

The science of forestry, therefore, has for its object the treatment of forests in such a manner as to insure the continuous production of timber and other forest products for the uses of trade and industry and for the requirements of the people. In

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short it aims at the preservation of the forests by wise use. This wise use restricts extraction to the increment of the forest and avoids exploitation which encroaches on its capital value.

Forest administration is, therefore, estate management on a large scale. The management of a forest estate however differs materially from the management of an agricultural estate. A tree crop takes many years to mature. A teak tree, for instance in the natural forest may take 150 years to reach timber size. A manager of a forest can, therefore, only in rare cases live to see the young crops that he has tended reach a stage when they are fit to reap. Whereas the manager of a farm can reap the fruits of his labour yearly. A manager of a farm has to think in terms of acres and years, but the manager of a forest has to think in terms of square miles and centuries. It follows, therefore, that mistakes in forest management are liable to be more far reaching and expensive than mistakes made in agricultural management.

Burma has the distinction of being the first province of the British Empire in which scientific forestry has been developed and the province was singularly fortunate in that a man of outstanding ability was selected to organize the Forest Department. Dr. Brandis arrived in Burma in January 1856 on appointment as Superintendent of Forests in Pegu. To his ability, judgment and untiring work is due the introduction of ordered forest administration in Burma and its sequence of an assured and expanding revenue from forests managed as far as possible on scientific principles. It is hard for us now to realise the difficulties under which Brandis laboured when he laid the foundations of the Forest Department in Burma. He arrived in an entirely new country. There were no maps and no roads The forests were unknown and the only names of the trees were those that had been given to them by the people living in the forest. He had to deal with both people and officials who had no conception of the difference between forest management and exploitation of resources. The only tangible thing he had to guide him was the outstanding value of teak and the fact that this value had so impressed the Burmese rulers that they had taken steps to have it

respected as a royal tree. No species other than teak had any appreciable market value in those early days. Brandis, therefore, concentrated on collecting statistics to regulate the yield of teak and drew up rough working plans to regulate the girdling and to insure that extraction was brought under system and control.

I shall now touch briefly on the various aspects of Forest Administration.

Extraction and Utilisation.—I take extraction and utilisation of the products of the forest first as extraction and utilisation form the beginning and end of all forestry. Without extraction and utilisation there would be no forestry and the final object of all forestry must be extraction and utilisation. Utilisation of the products of the forest by the local people has existed for ages. In fact at one time Burma must have been entirely covered by forests. This local utilisation varies from the extraction of a few bamboos and climbers to build a hut to the clearing of large areas for the purposes of a *taungya*.

In the good old simple days when there were not nearly so many people in the country the villager had the forests almost at his door step. His requirements were very simple. His house was built of bamboos tied together with canes, creepers, or fibre and thatched with grass or leaves. If he wanted anything from the forests he had only to take himself and his bullocks or buffaloes, if he had them, into the forest cut down what he wanted and bring it back with him Peace and prosperity soon changed these simple conditions. More and more land was cleared for cultivation and as a result the forest got pushed further and further away from the village. At the same time increased prosperity had increased the wants of the villager. He was no longer content with the simple bamboo hut but wanted a wooden house or at least a house with wooden floors The good old simple days were finished. The forests had been replaced by cultivation. In many cases there were no forests left to supply the wants of the villager within reach of him and these wants had increased The individual villager could no longer make the long journey to the forest for his requirements. Others had to

be sent for the purpose and so the trader in forest produce was evolved.

So far as Burma is concerned the export trade was evolved long before the internal trade in forest produce began to develop. Teak has probably been extracted and utilised from Tenasserim for centuries; but it is doubtful if there was much extraction elsewhere in the province before the beginning of the 19th century. When the British occupied Pegu in 1852 the trade extraction of teak was still confined to the easier plains and foothills and had not penetrated into the main hill forests away from the banks of floating streams. The use of elephants for extraction was unknown outside Tenasserim until 1856. From Lower Burma extraction of teak spread to Upper Burma and at the time of the annexation in 1885, Messrs. The Bombay Burma Trading Corporation, Ltd., had already large interests in teak there.

Owing to its value and the fact that by girdling the teak tree the timber can be rendered floatable, teak is extracted throughout the province and the areas classed as inaccessible to its extraction are negligible. *The combined process of marking* the tree for felling and killing it to render the timber floatable is known as girdling. From the beginning the Forest Department insisted that only trees selected and killed by officers of the Department or naturally dead trees should be extracted. After a struggle they got this principle enforced and it has formed our main safeguard against over-exploitation.

In addition to its own output Burma handles large quantities of teak from Siam and Karenni which come to Moulmein *viâ* the Salween river. A study of past figures is interesting. It shows a steady progressive increase in the Burma output in spite of regulation of the fellings and obvious exploitation followed by a collapse in the case of the Karenni output. In 1874-75 the teak output handled in Burma totalled 200,000 tons of which two-thirds was timber received *viâ* the Salween from outside British territory and the remaining one-third was timber from Burma proper. In 1924-25 to a total output of just under half a million tons. Karenni and Siam between them contributed less than 3 per cent

The trade demand for timbers other than teak is of more recent growth. It had been growing steadily since the British occupation. No reliable figures are, however, available for the earlier extraction as control of the extraction of unreserved species was only introduced in 1883. By 1900 the trade output of the province had exceeded that of teak and it has steadily increased since then though for the past five years it has been slightly under the teak output. In addition to the trade output there is a heavy free and uncontrolled extraction from the unclassed forests for domestic and agricultural use.

The annual trade output of firewood has recently averaged just under a million tons and the royalty value of bamboos and other minor produce extracted is just under nine lakhs.

So far as teak is concerned the resources are being worked to their full capacity So far as the utilisation of the other products of the forest is concerned it cannot be said that we have reached an advanced stage of development. We have yet to find uses for many of our timbers and other products. We know that we have many beautiful timbers and vast resources of bamboos suitable for the production of paper. We also know that so far these resources have not tempted capital to develop them and that much careful study and research are necessary before they can be developed properly. Our forests consist for the most part of hundreds of different tree species mixed, and out of the mixture comparatively few species repay the cost of extraction under present conditions. The country is difficult and the timber will not float. Extraction is, therefore, expensive and the extent to which it will pay to develop many of our forests by roads depends entirely on the extent to which research succeeds in finding uses and markets for our less valuable timbers.

The ways in which the products of the forest are exploited are many and various. We have the *taungya* cutter who may thoughtlessly cut down a patch of trees worth a thousand rupees to enable him to produce his year's supply of paddy. The forest has no value to him but his action must remind others of the tale of the man who burnt down the house to roast the pig. We have the villager who thoughtlessly exploits the fuel supply of his

village for his immediate gain and the trader who wants to cut out everything that can be sold at a profit regardless of the future. Finally we have the working of teak and the working in reserved forests which the Forest Department endeavours to regulate on a basis that will preserve the resources as an asset to the nation.

The extraction and marketing of timber on a profitable basis is by no means a simple or easy matter. It involves experience and study of trade conditions and markets throughout the world and a very heavy capital outlay. It is possible for the small man to make a reasonable profit under easy conditions; but as soon as conditions become difficult an agency with capital has to step in and the small man has either to drop out or to co-operate with the larger organisation.

Protection.—After utilization comes protection. The forests require protection against destructive influences. So far as Burma is concerned the chief destructive influence at present is man. For ages the people living near a forest have been accustomed to take what they wanted from it without let or hindrance, to clear it for their crops, to graze their cattle in it, to burn it and generally to maltreat it. As a result the forest has been driven further and further away from the villages and the villagers find greater difficulty every year in getting their requirements. It is probable that they realise that this wasteful and unregulated use destroys the forest. But they think that as a whole it is inexhaustible and they have only to go further afield to satisfy their requirements. The trader takes much the same attitude as the villager. Protection aims at regulating and if necessary restricting the use made of the forest to what the forest can safely stand.

Legal authority.—It was obvious when Government decided on administering the forests that some legal authority for this administration was required. I quote Baden-Powell, our great authority on Forest Law. "The practical experience of every civilized country has proved that a special law is necessary for the protection of Forest Estates. A forest is really as much the subject of property as a garden; but owing to its natural origin in most cases people have an inveterate tendency to regard it as

free to all. Thus a number of offences are committed in a forest which though individually unimportant, in the aggregate or if allowed to become common would be very serious hindrances to orderly forest working and might even render it impossible to preserve the forest as such. It is desirable to have such petty offences punishable by mild and suitable means and by a summary and easily applied procedure. They need also to be directly and simply declared by law without requiring to apply, by elaborate legal reasoning, the penal definitions found in laws primarily directed to other objects.

"Then too, forest produce in transit needs special protection. Timber in a river is often subject of theft either by the villagers who saw it up or by traders who cut out marks and put on their own. Lastly the income from the forests goes to the State and incidentally relieves the public from taxation. It needs, therefore, special facilities for its direct and punctual realization without the delays of a civil suit."

Forest Rules were framed for Pegu as early as 1856 and gradually legislation to protect and administer the forests in Burma was evolved. The various Acts and Rules were finally consolidated in the present Forest Act of 1902.

Constitution of State Forests.—A primary essential of all estate management is that the tenure of the land should be settled. As soon therefore as reasonable progress had been made with the organization of the Forest Department the question of setting aside reserved forests as permanent forest lands was taken up. It may be asked why it is necessary to reserve forests and why simple protection by rules is insufficient. Experience has proved everywhere that it is impossible in practice to enforce protection of a forest by rules It is absolutely necessary for protection of a forest to determine and regulate the various rights of user. Without such determination and regulation as the population increases the vague and unregulated rights of user are exercised not only by the local people but by those from a distance who have been eaten out of their own forest and gradually the forest disappears before over-extraction, grazing, burning and unsystematic use generally. Systematic regulation of use is

essential to the preservation of a forest. For this clear and defined boundaries and an authoritative settlement of rights of user over the forest are absolute necessities. There is not the least doubt—experience has proved it everywhere and is proving it in Burma—that in process of time every forest area, whether protected or not, in which various undetermined rights of user exist will disappear. It may take over a hundred years, but the deterioration and ultimately complete disappearance of such forests as forest is as certain as anything can be. Reservation was concerned at first mainly with the selection and demarcation of valuable teak producing areas. Progress was slow and difficult especially at first. The country had not been properly mapped. There was a general suspicion of the Forest Department and all its works on the part of officials to whom the idea of systematic forest management was novel. No definite policy of reservation on broad lines was laid down and the policy forced on the Department was one of opportunism pure and simple. As a result a patchwork of reserved forests has been built up. Instead of demarcating out on broad lines and settling the tenure of all unoccupied land, patches of forest of known value were reserved as opportunity occurred and extensions were gradually built on to them in later years. The process was uneconomical in time and unsettling to the people, who never knew when proposals to reserve a new patch would be sprung on them.

The total area of Burma is placed at 265,000 sq. miles including some 16,000 sq. miles of unadministered territory. Of this area 148,000 sq. miles are classed as forest land, including 31,000 sq. miles of reserved forest. The remaining 117,000 sq. miles are graded as unclassed forest. The condition of this unclassed forest is that the accessible areas have been largely depleted of marketable timber, in places even of marketable firewood, and that the less accessible and inaccessible areas are suffering from continuous and progressive depredations owing to *taungya* cultivation. As the tenure of the land has never been definitely settled the Forest Department is powerless to remedy matters.

There is little doubt that the question of the settlement of forest land has not received the attention that its importance

justifies. The distrust of our operations, which was to a certain extent fostered by the fact that our staff was inadequate to deal effectively with the areas in its charge has largely vanished. There are now proper maps to show the position of forest land over the greater part of Burma. It is hoped that in future a broader policy will be admitted to allow of as much as possible of the unclassed forest being absorbed either by reservation or allotment to the villagers as communal land The ideal to be achieved is a settlement which will allow of the villagers protecting areas definitely allotted for their use and the Forest Department regulating extraction and use over the remainder of the forest land

(To be continued.)

A RESUME OF FOREST PRODUCTS RESEARCH IN THE BRITISH EMPIRE DURING 1923—1926.

By R. S. Pearson.

Commonwealth of Australia.

Brief History.—No Central Forest Products Research Laboratory exists in Australia, and the work which has been carried out has been spasmodic, and due either to a special investigation of urgency presenting itself or to the individual effort of an officer attached to a University or other organization. The work done in the past by the various States and individuals has, however, not only created a basis for future work, but aroused sufficient interest and demonstrated the value of this class of research, with the result that the creation of a Central Forest Products Research Section is being seriously considered. The lines on which such an Institute should be developed, have been laid down in a report submitted by Sir Frank Heath, K.C.B., to the Rt. Hon. the Prime Minister of the Commonwealth of Australia, and published by the Government of the Commonwealth in March 1926. The following paragraphs briefly review some of the work carried out in different subjects by various research officers.

Mechanical Properties of Timber.—One important work on Timber Testing is that on Western Australia hardwoods, carried out by Mr. G. H. Julius for the Railway Department in 1906

A number of miscellaneous tests have been carried out by various Universities on the more important timbers of their State, but such tests were not in most cases carried out according to what are now known as standard methods.

Seasoning.—The work carried out under this head has been confined to private enterprise, primarily by firms interested in lumber and in motor-body construction. Mr. Tiemann of the Madison Laboratories visited Australia to investigate the possibilities of kiln-seasoning Australian hardwoods, with the result that a battery of water-spray experimental kilns was erected by the Perth University of Western Australia, which were operated by the Engineering Department of that University, in collaboration with the Forest Department. The work undertaken was chiefly on jarrah *(Eucalyptus marginata)*. At the same time the State Forest Service of Victoria erected a slightly different type of kiln, in which experiments were conducted on hardwoods in which they were interested.

Wood Preservation.—Experimental work was started in Wood Preservation in 1913, at the Adelaide University, the results of which have since developed into a somewhat wider investigation on commercial lines. The Powell process has through a series of years been greatly developed in Western Australia, chiefly in connection with the treatment of Karri timber (*Eucalyptus diversicolor*), and not only has the process been greatly improved, but the cost of operation considerably reduced.

Physical Properties and Uses of Timber.—More work has been carried out under this head than under any other, and Mr. R. T. Baker, of the Technological Museum of Sydney, has published what may be considered the most comprehensive work on Australian timbers, entitled "Hardwoods of Australia." The various Forest Services, as also timber firms, are endeavouring to create new markets for different species of timber, and though in some cases with success, they are much handicapped for want of definite information as to strength values, and machining and seasoning qualities of the timbers in which they are interested.

Paper Pulp.—Here again Mr. R. T. Baker has started investigations to prove the suitability for the manufacture of pulp and paper of certain species found in the Eastern States, while in Western Australia similar work has been carried out in collaboration with the Commonwealth Institute of Science and Industry. Later, Mr. Benjamin, working at the same Institute investigated Victorian and other species of timber in connection with the manufacture of paper-pulp.

Minor Forest Products.—A tan survey, chiefly dealing with wattles, was carried out in 1925 in South Australia, while similar work was carried out at the same time in Western Australia. A considerable amount of work on essential oils has been undertaken at the Institute of Science and Industry, Melbourne, in connection with eucalypts, while manufacturing chemists have paid attention to gums, resins, and oleo-resins, obtained from the forests.

BRITISH INDIA.

Brief History.—The organization set up in India and Burma to deal with Forest Products Research is twofold and consists of a Central Research Station known as the Economic Branch of the Forest Research Institute at Dehra Dun, which is controlled by the Central Government, and organisations known as Utilisation Circles, controlled by the Provincial Governments, which are in charge of Conservators or Deputy Conservators, according to the importance of the forests in each locality. In Provinces, such as Burma, Madras and the United Provinces where the forest revenues are very considerable, research stations have been created and the necessary technical staff appointed under the control of the Utilization Conservators. The idea underlying this system is that the more technical and scientific work should be carried out at Dehra Dun, and that the Provincial Research Officers should apply the results obtained at the Central Institute on broader lines and act as a liaison agency between the Territorial Forest Officers and the Commercial World.

The Economic Branch, which in other parts of the Empire is designated a Forest Products Laboratory, is one of the five

branches of the Central Forest Research Institute at Debra Dun. It was started in a modest way in 1906, was gradually expanded, notably in 1914 and 1919, and now comprises six sections, namely those of Timber Testing, Seasoning, Wood Preservation, Paper-Pulp, Minor Forest Products and Wood-Working and a sub-section of Mechanical Engineering. Exclusive of the main building which accommodates the head office of the Forest Economist, certain laboratories and two large museums, the cost of the laboratories, workshops, plant, land, power and water supply came to approximately £120,000, while the current annual expenditure on staff and research work amounts to somewhat over £30,000. The total staff employed varies from 250 to 300 men.

Objects aimed at.—The objects aimed at by the Institute are to improve present methods of utilization of both Major and Minor Forest Produce, to find new uses for different species of timbers and to assist persons interested in Forest Products. To give in detail all the results obtained is not possible, though a few concrete examples may indicate what has been accomplished by each section.

Timber Testing.—The Section of Timber Testing has carried out over 100,000 routine and special tests; tables and charts of strength values of many of the more important species have been prepared; grading rules for working stresses have been prepared for the Military Works and the Public Works Department; extensive work has been carried out for the Indian Railways in connection with sleeper woods; tests on Burmese woods as substitutes for American hickory for oil-well sucker-rods have proved successful, and tests are being carried out on gun-carriage poles for the Ordnance Department and on aeroplane spars for the Royal Air Force.

Seasoning Investigations.—Extensive air-seasoning experiments have been carried out by the Section of Seasoning in nearly all provinces of India, and have yielded data of great value, the kiln-seasoning of timber has received special attention, and has resulted in this method of seasoning being

introduced on commercial lines in various places; notably at the Jubbulpore Gun Carriage Factory, the Ishapore Rifle Factory, and by the Burma and Madras Governments in their exploitation projects.

Wood Preservation.—Wood Preservation was practically unknown in India until it was taken up by the Economic Branch: now, due to its activities, the largest Railway in India has erected a creosoting plant, another has been erected in North Assam; and similar schemes are being considered by other railways and private firms.

Paper Pulp.—To the credit of the Section of Paper Pulp is due the new industry in India for manufacturing pulp and paper from bamboo A large plant has been erected in Calcutta using nearly exclusively bamboos for its raw material, while two others are under consideration, one in the Madras Presidency and the other in Bihar and Orissa. Further the bamboo pulp supplied by Dehra Dun is now being tried out for the manufacture of artificial silk.

Minor Forest Products—The Section of Minor Forest Products had to be held in abeyance for many years, due to want of funds: nevertheless due to its activities, the Palamrosa or Rosha-oil industry has been put on an entirely new footing by the introduction of up-to-date methods of distillation. Under this section also falls that of " tans," which functioned for seven years, and carried out extensive surveys in the oak, chestnut and mangrove forests and issued exhaustive reports on the subject. This Section has now been revived and is interesting itself more especially in match woods, *salai* (*Boswellia serrata*) gum-oleo-resin, and improved methods of charcoal production.

Wood Technology.—The Section of Wood Technology has prepared macro and microphotographic slides of most of the important timbers of British India, and a complete treatise on the structure, seasoning, working qualities and uses of some 350 species of timber is under preparation and is well advanced. This Section is temporarily in abeyance.

Wood-Working.—The Section of Wood-Working is responsible for the sawmill and wood workshops and also the experimental veneer plant. All samples for use in other sections are prepared by this unit, while the value of many Indian timbers has been established for veneer work, for decorative purposes, and as plywood for packing-cases.

Forest Products Research in the Provinces.—The Burma Forest Products Research Station was started in 1921 and is situated in Rangoon. It is equipped with a sawmill, experimental seasoning-kilns and air-seasoning sheds and a very complete wood-workshop, where the machining qualities of Burmese timbers are tested. The Madras station is of somewhat more recent date, and is run by the Madras Forest Service as a combined commercial and research organization. A very extensive research establishment was developed some years ago at Bareilly in the United Provinces, as a pioneer commercial and research institute, the units of which, with the exception of the Government Wood-Working Institute, have now been absorbed by commercial concerns. In the Province of Bihar and Orissa there is a very active, though at present small, Forest Products Research organization, which shows every promise of expansion. Similarly, in the Punjab there is a Utilization section, which is largely concerned with improving markets for forest produce and which has been instrumental in creating a very lucrative rosin and turpentine industry.

From this brief review of the activities in Forest Products in India it may be gathered that the research organization in this subject is very complete, while the great advantage of the close co-operation between the Central Institute and the Provincial organizations largely contributes to its success.

DOMINION OF CANADA.

Brief History. Research at Montreal.—The need for research into Forest Products began to be felt in Canada early in 1911-12, the movement having the strong support of the McGill University of Montreal, with the result that in 1913, the nucleus of a laboratory was established under the Forestry Branch of the Department of the Interior. This organization co-operated with the

McGill University, who loaned the necessary buildings and land at a nominal rental.

The Laboratory at Montreal began with the three divisions, Timber Tests, Timber Physics, and Pulp and Paper and the organisation was very soon expanded to include Wood Preservation, Pathology and Chemistry. Mechanical testing of timber was arranged for in the testing Laboratories of the University, the University granting the use of its equipment in so far as it did not interfere with the instructional classes of the Faculty of Applied Science. The only testing machinery that the Government provided were two machines, a 30,000 lb. Universal Testing Machine and an Impact Machine.

The organisation of the Laboratories at Montreal as at first developed, consisted of a Superintendent, Assistant Superintendent and the officers in charge of the four divisions of Timber Tests, Pulp and Paper, Timber Physics, Wood Preservation and their respective staffs. Up to 1925, the total personnel was sixteen, while expenditure on equipment, amounted to approximately £10,000 Since then further commitments have been made in connection with the extension of the division of Paper Pulp.

Research at Vancouver.—During the War the demand for Sitka spruce brought into prominence the need for technical experience and advice on the Pacific Coast of the Dominion. The Forestry Branch of the Department of the Interior sent officers to Vancouver, and in 1917-18 a laboratory was founded in co-operation with the University of British Columbia in Vancouver City. This Laboratory for some years was purely for timber testing, working chiefly with the timber converters and the sash and door manufacturers to assist in the better understanding of the qualities of the timber of Western Canada. The other branches of the work, such as pathology, entomology and identification of timbers, were dealt with through the officers of the Faculty of Forestry of the University. Co-operation through these channels was remarkably efficient and no need was felt to establish divisions in the laboratory itself to deal with these subjects.

About three years ago, owing to the need for help and instruction in the matter of seasoning timber, an officer was appointed to take charge of kiln-drying and seasoning. A kiln was built at the new site of the University at Point Grey, where also the Government built a two-storyed building, with laboratories on the ground floor, offices above and a wood-workshop adjoining the main building.

The cost of equipping the Laboratory at Vancouver was about £8,000, while the annual appropriation for running expenses of both the Montreal and Vancouver Laboratories, prior to 1925, was in the neighbourhood of £18,000

Timber Testing.—Timber tests have been carried out on all the principal commercial woods of Canada, about 50 in number, and in some cases of more important timber on two or more consignments of the same species, taken from as many points in the range of its commercial distribution.

Tests have also been performed on timbers of structural sizes and lately work has been begun on testing boxes and crates of various designs. Investigations on mine props, transmission-line material, timber for flying boats for forest patrol and implement and wagon-parts have been conducted at different times.

Timber Physics.—Timber Physics Division has worked steadily in preparing a reference series of all the timbers, both commercial and otherwise, of Canada and has done excellent work in assisting in identifying timbers for manufacturers and others. This Division is carrying out tests on fire-proofing of timber and processes to be adopted to retard the burning of timber. Work has also been undertaken to improve the manufacture of sporting requisites, such as skis and tennis rackets and use of laminated material.

Pathology.—The Sub-division of Pathology has done excellent work in the matter of improving mill roof construction, where formerly through faulty design the wooden covering of the roof was rendered open to fungal attack, especially during winter months.

Wood Preservation.—The Division of Wood Preservation has been almost constantly employed by the railways and the telephone

and telegraph companies of the country, in establishing treating schedules for their material. Experiments in the treatment of different species and the use of cheaper preservatives have done much to lower the cost of preservative treatments for these companies.

Utilisation.—Many instances could be cited where the Laboratories served the manufacturers and consumers of timber in assisting them to find suitable and frequently more efficient substitutes to take the place of imported timbers.

Pulp and Paper.—Great advances were made in the Division of Pulp and Paper towards improving the methods of pulping and in one case the method of pulping certain species has been so modified as to increase the yield 100 per cent. A small digester was installed in 1924, to assist in the investigation of paper-making qualities of straw from the Prairies, which heretofore has been a waste product

Recent Development in Pulp and Paper.—As a result of negotiations between the Pulp and Paper Association and the Department of the Interior, an agreement was reached in 1925, whereby the Assoication would supply £4,000 annually for a period of five years and in return would have representation on the committee to deal with matters of policy and staff.

So encouraging was the progress under this arrangement that before the period of five years had elapsed a further arrangement was made between the Department of the Interior, the Canadian Pulp and Paper Association, and the Department of Cellulose Chemistry of McGill University, to establish an up-to-date laboratory for investigations into the more economic production of Pulp and Paper. Under this arrangement the Department of Cellulose Chemistry will carry out investigations into the fundamentals underlying the processes; the Government Laboratory will carry through laboratory investigations and semi-commercial tests, while the Pulp and Paper Association itself will deal with the commercial application of results and the dissemination of information. The total commitments by the Pulp and Paper Association amount to approximately £70,000, exclusive of equipment, which has to be arranged for in the near future.

As examples of the activities of the Canadian Laboratories during one year, a list of projects and other works is taken from a recent annual report of the Director of Forestry and is given in Appendix I. *(To be continued.)*

RECENT DEVELOPMENT OF FOREST MANAGEMENT IN THE PLAINS FORESTS OF FRANCE.

Prior to about 1837, the whole of the French State Forests were managed under the 'Tire-et-Aire' system. This consisted of dividing the forest into as many coupes of equal area as there were years in the rotation, and cutting one coupe each year. A definite number of standards (the number depending on the species) were left as seed-bearers to stand for the next rotation. The forest was not always previously divided on the ground into equal areas, but each year, the requisite portion of the total area was selected and exploited For simplicity the coupes were usually taken consecutively and thus in about 1837 the forest which had for some time been systematically worked by this method generally presented a regular configuration.

It was not until about 1850 that French foresters began to follow the lead which Harting and Cotta had set in Germany. In 1864 we find in the 'Revue des Eaux et des Forets' an eulogy by Schwarz on a method of dividing up the forest for management purposes, devised and applied some years previously to the 24th Division by its inspector, M. Epinasse This was, in effect, the ordinary method of dividing the forest into series, self-contained periodic blocks and compartments. It had for its objects the simplification of management and economy in personnel.

The steps to be taken in the sub division of the forest on these lines were as follows :—

First, the forest was surveyed, and boundaries, soil, exposure, situation, species and age classes were marked on the map in dotted lines. Next the forest was sub divided on the map into divisions of an arbitrary but convenient size which were called series, taking into consideration, where possible, natural divisions

of the forest. Then the rotation and the number of 'affectations' (or self-contained periodic blocks) to be used were determined, and each series was divided into this number of equal areas.

He says "The procedure which we propose to adopt is to divide, also on the ground, each of these 'affectations' thus established into divisions (*i.e.*, compartments) of regular form and equal area, and equal in number to the periodicity in years adopted for the thinnings." The boundary lines of the compartments were to run for preference from north to south, and east to west, or in the hilly country to follow the contours of the hills.

After this sub-division, the working plan was written for the whole rotation, providing for the regeneration of each 'affectation' in its own definite period, and regulating the annual yield by volumes after a total enumeration of the standing timber in the periodic block under regeneration. The thinnings in the remaining parts of the forest were regulated by area.

The advantages claimed for this system were chiefly concerned with management, for the simplification of which it was indeed intended. Easy location of any part of the forest was made possible, and the ten metre wide grass track with which the compartments were separated under the scheme rendered the transport and temporary storage of the exploited timber more simple. Finally the contractor who bought the timber would have no difficulty in finding his property. It must be pointed out, however, that the conception of the self-contained periodic blocks was rendered comparatively easy to apply in France by the regular succession of age classes resulting from the old 'Tire-et-Aire' system of consecutive annual coupes.

The division of the forest into compartments made under this scheme remains to-day. A perpetual re-writing of working plans (laboriously prepared to last for hundreds of years) was, however, found necessary owing to changes in the ideas on rotation, the periodicity of thinnings, method of regeneration, etc. This gradually showed that the demarcation of every periodic block throughout the forest was wasted labour and the idea gradually evolved of fixing one self-contained periodic block only

(*i.e.*, that under regeneration) sometimes indicating the second in order to enable the forest officer to regulate his thinnings in this with reference to the approaching regeneration. The rest of the forest was classified into age classes, generally termed groups and the thinnings were carried out here as usual by area.

At the same time the idea of self containedness of the periodic blocks got into difficulties. It soon became recognised that the waste of timber and money involved in the attempt to make all the periodic blocks self-contained, by regenerating stands not yet mature in one 'affectation' and keeping over-mature timber in other 'affectations' whose turn for regeneration had not arrived, was completely indefensible. The simple conception of self-contained periodic blocks being insisted on, it became necessary to make a series of 'temporary' exchanges of compartments from one periodic block to another to avoid this waste. The absurdity of this system may be seen in the forests of Perseigne, in one of whose series none of the compartments in the 'affectation' under regeneration is actually being regenerated, all having been 'temporarily' exchanged for compartments in other 'affectations.' Even when less used the method of exchanges is clumsy and entirely destroys the object of the method of self-contained periodic blocks, which is simplicity. Recognition of this fact is leading to the abandonment of the idea of self-contained periodic blocks, though even to-day most of the areas under regeneration are composed of two or three blocks of compartments, as a result of the past history of the forest.

The latest development of management in France up to this time was the fixing of a single, not necessarily self-contained periodic block, the possible indication of a second, and the division of the rest of the forest into age classes. The whole of the fixed periodic block, was to be completely regenerated within the period of the working plan. Continued application of the shelterwood compartment system of obtaining natural regeneration soon proved, however, that it was practically impossible to obtain regeneration over the whole of the periodic block within the regeneration period. Indeed in the last few years of the period it became increasingly difficult to cut even nearly up to the

possibility, having sufficient consideration for the cultural requirements of the crop. This fact led up to the idea of revising the working plan completely before the end of the regeneration period, the regenerated compartments and parts of compartments (sub-compartments) being thrown out of the area under regeneration, and a completely new regeneration area being selected, containing all the partially regenerated area left over from the old periodic block. This method the 'Quartier Bleu' method of English literature* is the latest development of the French forestry, and first made its appearance about 1893. In applying it they still like to see their area under regeneration in as few pieces as possible though there is no longer any attempt to form self-contained periodic blocks at the expense of the crop. Under the 'Quartier Bleu' method, too, the French have given up the time limit to the periodic block and choose their area for regeneration on cultural grounds instead of fixing the period in advance, and choosing a corresponding area to regenerate.

The cultural considerations on which the choice of compartments for regeneration is made have been clearly formulated under the title of 'Judeich's' method. First, all partly regenerated areas are included. Next, areas deficient in increment, whether from understocking, the presence of inferior species, over-maturity, disease, etc., are put in. Finally, healthy crops which have reached the exploitable age are added. If the area thus chosen is too large, it is reduced by the exclusion of some of the third class of compartment, unless there is not enough of this to give a reasonable yield, when some of the compartments deficient in increment might be left out.

It must be remembered that only a few of the French high forests, such as those of Eawy in the 2nd Conservation, and Retz in the 19th Conservation, are as yet treated by the so-called 'Quartier Bleu' system. Still fewer are treated by the method of a single periodic block except as regards the hill forests (chiefly irregular forests under conversion to uniform) of the

* The term 'Quartier Bleu' conveys an entirely different meaning to a French Forest Officer.

Vosges and Juras. Among the plains forests, the forest of Blois in the 19th Conservation is treated in this manner.

The vast majority, however, are still treated under the old method of self-contained periodic blocks and its attendant method of exchanges. Among these latter are included the 'classical' forests of Lyons-la-Foret in the 2nd Conservation, of Bercé, Bellême, Bourse and Perseigne in the 15th Conservation, and the forests of Russy in the 19th Conservation, together with numerous other forests of less importance. This is due, not to the failure of the more modern methods of management, but to the conservative nature of the French forest authorities, and their respect, almost amounting to reverence, for the old Parade tradition which did so much for French forestry in the middle of the last century.

Special factors attending the application of the 'Quartier Bleu' Method.

The uniform system combined with one of the above described variations of the method of periodic blocks is now universally used in the Plains High Forests of France*. The major yield is in all cases fixed by volume after the enumeration of growing stock on the area under regeneration. Allowance is sometimes made for increment, but it is more usual to remeasure the growing stock every ten years and fix the yield for the ensuing period†. Uniform seed fellings over a whole compartment are made, while subsequent fellings follow the needs of the regeneration. The actual order in which the compartments are seed-felled is left to the discretion of the Forest Officers. Thinnings are carried out by areas, the actual area of each age class thinned each year being equalised as far as possible. Decennial thinning in middle aged crops with more frequent thinning in young crops are

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* The Maritime Pine Forests of the Landes may be said to form an exception

† This, of course, leads to an undercutting of the real possibility, but this is desired by the French forest authorities to create reserves. Sometimes part of the timber standing on the regeneration area is deliberately put aside to form a reserve, e g., in communal forests where as much as 25 per cent. (le quart in reserve) is sometimes deducted from the annual yield

the general rule. Finally the normality of the forest is judged by area, *e.g.* forest containing equal areas of all age classes is considered normal.

On two points in particular the 'Quartier Bleu' method differs fundamentally from the older uniform system. The regeneration period is not prematurely fixed, but the area for regeneration is first chosen on Judeich's system, and its period then determined. Also the working plan is completely revised before the end of the regeneration period and a new regeneration area selected.

The advantages of the system are twofold. The use of Judeich's method allows the inclusion in the 'Quartier Bleu' of all areas needing regeneration, irrespective of their age or distribution on the map. Also the larger area available for regeneration in the last years of the working plan enables the Forest Officer to carry out his regeneration fellings according to the requirements of the crop, at the same time obtaining his annual yield. On the other hand, each of the differences from the older uniform system introduces new difficulties and dangers. To begin with, in fixing the regeneration area in the 'Quartier Bleu' system, partly regenerated areas must be included. In determining what period of years is represented by the 'Quartier Bleu' these areas have to be assigned a reduced area, or else the determined possibility will fall short of the real possibility. In France this is usually done by Duchauffour's method which consists in multiplying the mean diameter of the trees enumerated by a factor representing the ratio of crown diameter to stem diameter. The crown diameter of the average tree is thus obtained and this figure squared multiplied by the number of trees considered as the reduced area of the compartment. The remaining area is reckoned in the working plan as that belonging to the youngest age class.

The blind application of Judeich's method may in some cases lead to the formation of a regeneration area amounting to one-third or even one-half the total area of the forest, which

is dangerous except in very small intensively worked forests.*

This disadvantage can easily be overcome by omitting some of the less urgent compartments from the regeneration area, thus cutting its period down to reasonable limits. Frequent revisions of the working plan to force the Forest Officer by careful supervision to keep his regeneration under control, seems to be rather a case of shifting the responsibility for a difficult job, without really solving the problem. In addition, it would mean a great development of the working plans department, thus raising the cost of maintenance of the forest staff. It seems more reasonable to give up the long regeneration period, in extensively worked forests, thus removing the necessity for elaborate control

A further disadvantage comes into force with the revision of the working plan before the end of the regeneration period. If the overlap between the two periods (the working plan period and the regeneration period) is too long, there will be a renewed tendency to shelve the regeneration of the more difficult compartments (usually the most urgently needing attention) till after the next revision of the working plan, and so on for ever. The simplest way of avoiding these dangers is to limit the period of overlap to a few years only, thus forcing the Forest Officer to start regeneration in all his compartments and to finish most of them. It is probably better to allow too little rather than too much overlap, although in this case it should be made possible to get permission, if necessary, to regenerate compartments outside the 'Quartier Bleu' towards the end of the period of the working plan. The danger of neglecting difficult areas can also be avoided very simply by laying down in the working plan the order in which the compartments are to be attacked. It is also possible, if necessary, to assign an outside limit to the number of years which

* A large regeneration area is used with success in combination with the 'Femmelschlag betrieb' or group selection method in many places, in Switzerland. Divisions, however, are very small averaging 4,000 hectares A good example of the dangers of a large regeneration area may be seen in the High Forest of Baden near Gegenbach, where the regeneration fellings are carried out over a very large regeneration area. Regeneration has been started everywhere and finished nowhere The regeneration area was in this case designed to allow a careful regulation of species and the production is an undulating canopy for wind protection but the results show clearly the dangers attending this method.

may elapse between the seed and the final fellings in any compartment in order to ensure that the regeneration of difficult compartments is not neglected.*

Finally an objection to the 'Quartier Bleu' system has been raised on the grounds that it gives rise to the formation of large numbers of sub-compartments. On examination this argument seems to be unsound. The two types of sub-compartments formed are those formed by the regeneration of a block of old woods standing (for reasons over which the current working plan has no control) in the middle of a compartment of middle aged woods (or vice versa), and those sub-compartments which are formed by throwing out of the 'Quartier Bleu' completely regenerated parts of a compartment which is in the course of being regenerated. Over the maintenance of already existing sub-compartments of the first type the system of management has no control, unless it insists on sacrificing the timber to the uniformity of compartments. In the second case, however, the formation of sub-compartments is only a temporary measure, as the regeneration of sub-compartments will be proceeded with in the new period according to the requirements of the young growth. When this is completed the difference in the age between the sub-compartments whose regeneration was finished before and after the revision of the working plan will be no more than normal and the crop will even up in the usual manner. At the next revision of the working plan the sub-compartment boundary on the map will be removed, as there will no longer be any sub-compartments existing on the ground. Only if partly regenerated areas are forgotten after the revision of the working plan will new permanent sub-compartments be formed, and efficiency among forest officers should prevent this elementary mistake.

Even if more sub-compartments are formed, it is doubtful whether it could reasonably be objected to. The 'Quartier Bleu' system is in general the forerunner of a more intensive system

* This will necessitate the planting of areas not regenerated at the end of this time. Probably, however, the soil surface will have deteriorated too much to allow natural regeneration. A case of this occurs at Hagenau where three years after the exposure of the soil by seed felling it is found impossible to obtain natural regeneration.

of management and in the more intensive system the naturae divisions of the crop (*i.e.*, the sub-compartments) form the basis of the working plan, and not the relatively artificial compartment boundaries.

CAMBRIDGE : H. E. C.
March 1925.

DISTILLATION OF AGAR OIL.

This little known product (Sanskrit—*Aguru*) is extracted from the wood of *Aquilaria Agallocha*, in a few villages of the Sylhet division where the old crude method of distillation is still practised. The object of this note is to describe the process. *Agar* is a peculiar formation of the wood tissue found inside the *Aquilaria Agallocha* tree, a soft-wooded species growing in the evergreen forests of Assam. From outward appearance, there is no indication as to whether a tree contains *agar*. Indeed a large number of trees are felled yearly and every part of them cut open in the vain search for *agar*. The lessee thus loses money searching for this product while Government loses many valuable trees which would otherwise have served as mother trees, and which would, perhaps, have developed *agar* in the later stages of their life.

It is obviously high time that some knowledge was obtained of the conditions of growth and development of *agar* Investigation of the subject is, I understand going on in Sibsagar and the Garo Hills divisions where the plant is found in abundance.

Agar wood is classified into (*i*) real and (*ii*) *dhum agar*. The former is hard and brown while the latter is soft and light yellow to almost white in colour Real *agar* is seldom, if ever, distilled but is highly prized by Parsees and Arabs for burning as incense in their religious ceremonies. The oil is usually distilled from the *dhum*.

Chips of *dhum* varying in size from 1′ to 8″ in length are steeped in water in an earthern pot for about two days. They are

then taken out and cut into smaller bits with a billhook and finally pounded into powder, in much the same way as a villager husks his paddy. The *dhum* powder is now ready to go to the still. This is a circular copper pot about 30" in diameter with a lid, on the top of which is a circular hole about 2" in diameter, connecting by a galvanised tube to a bottle-shaped condenser about 1" in diameter. The condenser is placed in an earthern pot kept in a small pit filled with cold water. Ten seers of dry *dhum* is usually used in each charge. The *agar* is put in the condenser and water added up to three quarters of its capacity. The still is placed in an oven and plastered all round except at the top and bottom with mud 6" thick, and all joints are closed with mud and flour. The fire is kept burning under the still for 6 to 12 days according to the nature of the wood, better wood requires longer time to distill but gives a greater output. 20 to 24 maunds of firewood are required for each charge, and the distillation goes on from 8 in the morning to 5 in the afternoon daily. Water in the pit in the ground where the condenser is placed is kept cool by adding in cold water 10 to 15 times a day. A large quantity of water escapes by soaking into the soil and by evaporation and the method of cooling the condenser is generally unsatisfactory.

At the time of my visit I noticed that vapour was forming from the water surface and on dipping in a finger found it quite hot. Questioned as to why they did not keep the condenser cooler they told me that they thought it was cool enough

After the oil has been distilled over, it is scraped from the surface of the condenser leaving the water and other impurities. The oil thus collected is allowed to stand for a week or so when any water or other heavier substances settle to the bottom. The oil is then separated by decanting. The usual output of one charge is 6 to 20 tolas of oil. It sells from Rs 2-8-0 to Rs. 3-8-0 per tola. One can suggest a number of improvements on the existing method but the prejudice of the people against doing anything their forefathers have not done stands in the way.

R. N. DE, P F. S.,
D. F. O., Sylhet division.

REVIEWS.

AIMS AND METHODS IN THE STUDY OF VEGETATION

Edited by A. G. Tansley, M.A., F.R.S. and Dr. T. F. Chipp, M.C., B.Sc., Ph.D. Published by the British Empire Vegetation Committee and the Crown Agents for the Colonies, 4, Mi. bank, Westminster, S. W London, 1926, pp. xvi and 383. Price 12*s.* 6*d.*

The observant forester, or rather the forester, for the forester who cannot observe has no claim to being called one, in the course of his field work and more especially on working plans field work, notices over and over again a definite distribution of flora, an association of tree and shrub species and has wondered at the reasons why, and in some cases, in more recent times, has given tentative reasons.

But speaking generally the study of ecology, the branch of botany dealing with this distribution and association of species is a comparatively modern development in Indian Forestry. Consequently the book under notice will come as a most useful help to foresters who want to know the reason why in such matters, and as a real God send to the forester-botanist who seeks for a new hobby and how to pursue it.

To quote from the preface "It is hardly possible to conceive a property owner or stores manager carrying on the management of a large estate or general store and yet being unaware of the stock at his disposal, the extent of his supplies or their nature. *And yet this is, in the main the position of the British Empire*, its Tropical Colonies and Protectorates in general, and even, to a certain extent, its great Dominions, so far as one of its greatest assets—natural vegetation—is concerned. No inventory of the vegetational assets of the Empire has been attempted, nor, so far as is known, is any officially contemplated."

As regards the Indian Empire, in special reference to its Forest Department, a good deal has been contemplated and a beginning towards accomplishment has been made.

Thus the all-India Forest Utilization Conference, Dehra Dun, India, 1922, passed a resolution regarding the necessity for a regular and scientific industrial survey of India's forest resources. Many pamphlets have been published by the Economic branch of the Forest Research Institute, Dehra Dun, on individual timber species, their distribution and available supplies. Similar *information is available in Pearson's "Commercial Guide to the* Economic Forest Products of India" and in Troup's "Forest Wealth of India," the latter brought up to date by the writer of this notice for the British Empire Forestry Conference of 1920. But these publications barely touch the fringe of a vast subject and methodical and scientific effort is necessary if accurate data are to be made available within a reasonable period of time.

How often has the forester in India been told by a potential consumer "Yes, this timber species will suit us excellently. Now what about annual supply and average price?" For all but the

commoner species no reply was possible, and imported timber standardised for quality, size and price, got the order once again.

Then again who has not heard of the slow invasion in the N. W. Himalayan forests of India of the Indian spruce and fir, gradually but surely ousting the more valuable deodar and blue pine; or of the year-long efforts of foresters to bring in Indian 'sal' into areas where nature has determined that 'sal' shall not grow.

Interesting problems, both, and only two out of many. A perusal of Messrs. Tansley and Chipp's publication throws a new light on such problems.

The book is well arranged and is eminently readable. The first part deals with a general survey of flora and vegetation, goes on to describe plant communities and their conventional or suggested classification, stresses the necessity for botanical training as a preliminary to the study of regional vegetation and finally describes in detail the methods of investigating vegetation, surveys and the collection and preservation of specimens. Then follows a more specialised theoretical treatment of the subject.

The second part concerns the regional study of the problems, and Mr. L. Dudley Stamp, who is not unknown to Burma forest officers, writes instructively of what a forest officer can do to help. The remarks are so apposite that a quotation in full appears justified.

"What the forest officer can do? It need scarcely be said that those who are in the best position to carry out a vegetation survey in any country with a "forest climate" are the trained Forest Officers scattered throughout nearly all countries of the Empire. In the course of his daily work the Forest Officer comes very near to actually doing his work, there can be little doubt that a very small increase in effort could add enormously to knowledge. The same applies in nearly the same degree to Agricultural Officers, particularly those employed in grass and regions.

"A brief description of the method of making "Forest Working Plans," as used by the Forest Department in Burma, is here

introduced to show how near these plans are to a really satisfactory basis for a comprehensive vegetation survey. The Forest Department works along the following lines. After a preliminary inspection, Government decides that it is desirous, either to prevent ruthless exploitation and destruction or, for other reasons to declare a certain tract of land a "Reserved Forest." After considering the rights of local inhabitants, and any objections to the proposed reservation, the area is defined and, by public announcement, declared to be a Reserved Forest. Certain privileges, such as grazing rights, cutting of unimportant species and bushes and firewood, may be accorded to local villages, but otherwise the land virtually becomes entirely controlled by the Forest Department and is, incidentally, a game preserve. It is divided up into convenient-sized "compartments" say 500 or 600 acres each and the boundaries of the reserve clearly defined by a series of posts and by blazing trees along the boundary line. The area is then surveyed by the Survey of of India, usually on the scale of 4 inches to the mile, so that more accurate maps of the forests are often available than of any other part of the country. A Forest Officer ("Working Plans Officer") is then detailed to produce a "Working Plan" and a "Stock Map." The Working Plan forms a volume (usually privately printed for the Government) containing a description of the forest suggestions for improving the tree growth, and a scheme for exploiting the forest whereby regeneration will keep pace with exploitation. Estimates of the total yield of the forest are usually based on the enumeration of trees in sample square or rectangular plots. The Forest Officer is a busy man and is compelled to devote himself almost entirely to a consideration of the commercially valuable species of trees. As a rule, published reports give no description of ground vegetation—except of species regarded as pests. Geology and soil secure little notice. It is suggested that the Forest Officer, without departing from his legitimate duty, is in a position to assist a vegetation survey enormously, and, incidentally, to benefit his own Department. This might be accomplished by a very careful description of the Sample Plots. The geology, soil, aspect and climatic

conditions should be stated, followed by a description of the vegetation, any lower storey of shrubs which may exist, climbers, epiphytes, etc., as well as trees. A plan to scale of the plot is desirable, with insets showing the distribution of species on small sample quadrats.

"The stock maps produced by Forest Officers are not necessarily on a standard plan. Some show only the distribution of the most important species of trees, other divide the forest into vegetation types and are really, therefore, vegetation maps. The growing tendency to suppress the printing and publication of stock maps is much to be deprecated.

"The Government of India has recently ordered that Working Plans shall be on sale to the public, and there is little doubt that permission would readily be accorded to Forest Officers to publish detailed observations. The important part which geology and soil play in the distribution of vegetation types makes one regret that more attention is not paid to this aspect of the subject by foresters.

"It is realised, of course, that the Forest Officer has his own work to do, and often very arduous work. It is not suggested that the responsibility of making an extensive vegetation survey shall be officially placed on his shoulders unless, indeed, the Forestry Departments can be brought to see the essential value of such work and appoint extra staff for the purpose of carrying it out. Meanwhile, it is certain that extra observations and records, on the lines suggested, would provide most valuable data, and could be made with little extra effort.

"If the Forest Officer cannot undertake a primary survey, it is suggested that the monographic method of survey might be attempted. That is, a single type of forest is taken and traced in all its variations through the country, on different types of soil and in different atmospheric conditions. Such a study would be of immense value to Forest Departments, as well as of great botanical importance.

"Apart from the reserved forests, Forest Officers and Agricultural Officers are obviously the men most fitted to write descriptions and make maps of the country outside the reserves. They

are fitted best to distinguish semi-natural vegetation, which so often puzzles the less trained observer. All Forest and Agricultural Officers are compelled to travel about the country and have excellent opportunities for studying the vegetation of the country as a whole."

These suggestions are essentially practical and their being given in full will help Indian Forest Officers to take up regional studies of vegetation and advance the cause.

The third part consists of descriptions of types of vegetations in various parts of the world. Of special interest to the I. F. S. will be the excellent monograph of "Problems of Forest Ecology in India" by *Professor R. S. Troup, I.F.S., F.R.S.* (pp. 283-313).

Similar descriptions of forest ecological conditions of South Africa, Canada and New Zealand conclude the book.

The publication is well printed, there is a good index, and the reproductions of photographs are first class. The diagrams however lack a little in distinctness and general neatness of "get up."

The last page is devoted to giving briefly the aims and objects of the British Ecological Society and as this information will be of undoubted interests to many Indian Forest Officers no apology is necessary for printing the brief notice in full.

"BRITISH ECOLOGICAL SOCIETY.

'The object of this Society (founded in 1913) is to promote and foster the study of Ecology in its widest sense.

"*The list of members (January 1926) contains 182 names:* of these 20 belong to the overseas Empire, and 14 to foreign countries.

"Membership is open to all students of vegetation or ecology, and any such student, personally unacquainted with other members of the Society, may be proposed for membership by an officer of the Society on application to the Hon. Secretary.

"The membership subscription is twenty-five shillings per annum, and this includes free delivery of the Journal of Ecology to any part of the world.

" Further information may be obtained from the Hon. Secretary, Dr. E J. Salisbury, The Briars, Radlett Herts, England, to whom application for membership should be made.'

The Editors of " Aims and Methods in the Study of Vegetation " and their contributors have undoubtedly earned the thanks and gratitude of many Indian Forest Officers for their able exposition of a fascinating subject.

A. J. G.

ON THE SPACE ARRANGEMENT OF TREES AND ROOT COMPETITION.

V. T. AALTONEN, FOREST RESEARCH INSTITUTE, FINLAND.

(JOURNAL OF FORESTRY, OCTOBER 1926)

Starting from the well-known facts that the poorer the locality, the greater the growing space required by a tree of given diameter and volume, and the heavier the opening required for the establishment of regeneration Aaltonen stresses the view that foresters of to-day generally overrate the importance of light in silvicultural practice. He supports his own opinion that root competition is much more probably the deciding factor by pot experiments with corn, the simplest and most obvious being to grow plants in rooms separated in the soil by sunken vertical boards, or free to compete, and his figures certainly appear most conclusive. He also adduces in favour of this idea the results obtained by Wedemann with the 'Danerwald' system applied to pine and experience with underwoods of beech or spruce which, contrary to widespread belief, do not benefit the growth of the overwood, in fact sometimes definitely act in the contrary direction—the author even goes so far as to assert that the soil also cannot be shown to have improved. Again Schwappach's yield tables are quoted as showing that a greater total yield is obtained by heavy intermediate fellings on poorer quality classes and lighter intermediate fellings on the better localities.

The difficulty of assessing light values in the forest is well known but is no excuse for belittling its importance, as the author advisedly points out, referring us to the now well known work of

Cajander on 'forest types' as indicating a possible way out of the difficulty.

The paper appears to have been written with the object of directing more attention to the hidden underground portion of the tree and the factors influencing its development and, therefore, that of the whole-tree from seedling to seed tree. That this attention is needed is beyond dispute and one hopes this will succeed in attracting it.

H. G. C.

EXTRACTS.

THE IMPERIAL FORESTRY INSTITUTE, UNIVERSITY OF OXFORD.

SECOND ANNUAL REPORT, 1925-26, AND PROSPECTUS.

PREFACE.

The total area of forest in the British Empire is estimated at 1,837,000 square miles, of which some 685,000 square miles are at present accessib e and marketable. Much of this area has already been depleted by wasteful methods of working and by inattention to scientific methods of forest organization and silviculture. The serious situation which is likely to arise before long owing to the diminution of the world's timber supplies is a matter on which a good deal of comment has been made during recent years, and it is scarcely necessary to emphasize the importance of providing a thoroughly capable staff to administer and work the vast forest property of the Empire and of training research workers to deal with the various problems which concern Forestry. This was among the questions discussed by the British Empire Forestry

Conference held in London in 1920 and attended by delegates from all parts of the Empire. The Conference recognized that one of the first essentials was to provide for the more efficient *training of Forest Officers* and to afford better facilities for research in the various branches of Forestry. Among the measures recommended was the establishment in the United Kingdom of a central institution which should undertake the higher training of Forest Officers for the Empire and also be a centre for research into the formation, tending and protection of forests. This led to the appointment of an Inter-Departmental Committee whose function it was to collect evidence and make proposals regarding the location and organization of such an institution. This Committee issued in 1921 a report which recommended the establishment at Oxford, in close connection with the University, of a central institution for the higher training of Forest Officers, for the provision of special and 'refresher' courses for Officers already serving, and for the conduct of research into forest production. A second Empire Forestry Conference held in Canada in 1923 strongly supported this recommendation, and emphasized the necessity for taking immediate action: these views were endorsed by the Imperial Economic Conference held in London the same year.

The Imperial Forestry Institute was accordingly established at Oxford in October 1924, and has now completed the second year of its existence. The first year was taken up largely with the preliminary work of organization and equipment; but the second year, as will be seen from the Report for 1925 26, shows marked progress both in instructional work and in research. Although much remains to be done in completing the organization of the different branches of work carried out at the Institute, enough has already been accomplished to indicate the immense importance of such a central institution, not only to the British Empire but also to the progress of Forestry throughout the world. During the first year 22 students attended courses of instruction During the second year the number has doubled, and the number of new entries at the beginning of the third year together with applications for further admissions indicate that

there is likely to be a steadily increasing number of students in future.

The scope of the work of the Institute is set out in the prospectus. The point may be emphasized that the Imperial Forestry Institute is not intended to take the place of existing schools of forestry, whether in Great Britain or overseas, or to relieve such training centres of the responsibility of providing a thorough general training in Forestry. The Institute is intended rather to supplement such a general training by more advanced or specialized work demanding a more complete staff and more expensive equipment than it would be possible for the average school of forestry to maintain. From this point of view it should form a much desired link between the different training centres which are already in existence or may be established in the future in different parts of the Empire. The situation of the Institute, within easy reach of continental forests which have been managed along scientific lines for centuries and are thus a model for the guidance of countries where Forestry is a new subject, is an important factor. The happy liaison which has already been established between the Institute and some of the foremost authorities in Forestry on the Continent augurs well for the future development of practical training in continental forests as well as possible collaboration in solving some of the difficult problems with which Forestry is confronted. Although established primarily for the needs of the British Empire, it is hoped that the Institute will serve a useful purpose for other countries and will, in fact, benefit the cause of Forestry in general, since the question of the world's timber supplies is one affecting not only the British Empire but the whole world. The location of the Imperial Forestry Institute at a great University, which already possesses a flourishing School of Forestry and has always shown great interest in the progress of scientific Forestry, is another asset, the importance of which can hardly be over-rated. Oxford, with its scheme of Rhodes Scholarships, is already a great connecting link with the different parts of the Empire and with the United States of America. In this respect its soil is a particularly fitting one in which to plant a great

central institution for Forestry. Apart from the immediate staff and equipment of the Institute itself, the resources of the whole University are available, if need be, for the benefit of its students. The Director of the Institute is himself the University Professor of Forestry and Head of the School of Forestry.

The staff of the Institute during the past year has consisted, apart from the Director, of eleven members, of whom seven were full-time and four part-time lecturers. The subjects dealt with during the year were silviculture, forest management, the economics of forestry (including forest policy), mycology, entomology, systematic forest botany (mainly tropical and sub-tropical), the structure and properties of wood, surveying and forest engineering. In addition, facilities for giving special training in soil science were afforded by the Department of Rural Economy pending the development of this subject at the Institute. Arrangements have been completed for an expansion of the silvicultural branch and for the development of the teaching of forest engineering on practical lines.

The practical aspect of Forestry is fully recognized. Apart from the organization of tours in selected forests on the Continent, the liaison established between the Institute and the *British Forestry Commission* ensures that the practical point of view will be impressed on students attending the Institute. During the past year two research officers of the Forestry Commission were attached to the Institute as part-time members of its staff. By this means the details of investigational work and methods of research can be studied not only from a restricted point of view, but also in their practical application under large scale forest conditions. Another important liaison is that which has been established between the Imperial Forestry Institute and the Forest Products Research Laboratory. These two institutions work closely together, the Institute undertaking work of a more fundamental character and the Forest Products Research Laboratory carrying out tests and trials in respect of timber and other forest products on a scale adapted to commercial practice. It is hoped that the Institute will extend its activities in the direction of arranging special courses of instruction in

other centres whenever circumstances do not permit of their being given at the Institute The instance may be quoted of the case of two Forest Officers deputed from Nigeria for training in silvicultural research methods with special application to tropical condition. It is obvious that a complete course of training on these lines would be impossible in England. Hence after several months' instruction and practice in methods of fundamental research as applied to silvicultural problems, including soil problems, the two officers in question have proceeded to India under arrangements made by the Director of the Institute in order to study the methods of research carried out at the *Forest Research Institute, Dehra Dun, and the development* of methods of tropical silviculture in certain selected forest tracts in India and Burma. In the course of a few months these two officers will return to Oxford and complete their course of training, when they should be in a position, on return to Nigeria, to initiate experimental work on scientific lines.

The Governors consider themselves fortunate in having secured the services of Professor Troup as Director of the Institute. They are satisfied that there is no one engaged in Scientific Forestry to-day who is better fitted to superintend the organization and progress of an Institute of this nature. He has been able to attract a staff of highly competent lecturers who are loyally supporting him in his work

It may be said in conclusion that the Imperial Forestry Institute has already more than fully justified its creation, and that if it is given reasonable opportunities it will develop into an institution of the very first importance not only to the British Empire, but to the world in general.

But the development of the Institute, and indeed its existing work, is severely handicapped by the lack of suitable buildings. At present it is housed partly in the School of Forestry, partly in temporary buildings erected last year, and partly in a recently purchased house adjacent to the School. This accommodation is already insufficient, and the congested state in which staff and students have to work is not conducive to the best results.

The provision of funds for adequate buildings has become a matter of extreme urgency. Preliminary plans have been prepared, and the full cost of the buildings required will be not less than £75,000. Such a sum is beyond the means of the University to provide, but it is prepared to offer a site subject to a sufficient sum being raised for building. A public appeal for funds will be issued shortly, and the Governors have every confidence that with the help of money already offered for the purpose a sufficient sum will be raised from those interested in Empire Forestry to warrant the Board in embarking on a building suitable for all the purposes they have in view.

26th October 1926. CLINTON.

BOARD OF GOVERNORS.

The Rt. Hon. Lord Clinton, Forestry Commissioner (Chairman), the Vice-Chancellor, University of Oxford; Sir Herbert Warren, K.C.V.O., M.A., Hon. D.C.L., President of Magdalen College; Joseph Wells, M.A., Hon. D.C.L., Warden of Wadham College; Robert S. Troup, C.I.E., M.A., D.Sc., F.R.S., Fellow of St. John's College (Director); Roy L. Robinson, O.B.E., B.A., B.Sc. (Adelaide), F.S.A.S.M., Forestry Commissioner; Ralph D. Furse, D.S.O., B.A., Colonial Office; Sir George L. Courthope, Bt., M.C., M.P., Empire Forestry Association.

ACADEMIC YEAR, 1925-26.

STAFF.

The following was the constitution of the Staff during the year:—

DIRECTOR.

Professor R. S. Troup, C.I.E., M.A., D.Sc. (Oxon), F.R.S.

LECTURERS AND DEMONSTRATORS.

Silviculture: The Director; H. M. Steven,* B.Sc., Ph.D. (Edin.), Hon. M.A. (Oxon), Forestry Commission Research Officer attached to the Institute.

Forest Management: R. Bourne, M.A. (Oxon).

Economics of Forestry: W. E. Hiley, M.A. (Oxon).

Mycology: W. R. Day, B.Sc., M.A. (Oxon).

*Part-time Lecturers

Structure and Properties of Wood. C. C. Forsaith, Ph.D. (Syracuse, U.S.A.); L. Chalk, M.A. (Oxon.).

Entomology: J. W. Munro,* Hon. M.A. (Oxon), D.Sc. (Edin.), Entomologist, Forestry Commission, attached to the Institute; R. N. Chrystal, B.Sc. (Edin.), Hon. M.A. (Oxon).

Forest Botany: J. Burtt Davy, Hon. M.A. (Oxon), Ph.D. (Cantab.).

Surveying and Engineering. N. F. Mackenzie,* Hon. M.A. (Oxon.).

Forest Law: H. S. Williamson,* M.A. (Oxon).

Secretary: P. S. Spokes, B.Sc., M.A. (Oxon).

Assistant Secretaries: Miss K. M. L. Simpson, M.A. (Cantab.); Miss M. H. F. Coney, B.A. (Oxon.)

Librarian: Miss G. Guiney.

2. Towards the end of the year Dr. C. C. Forsaith left the staff owing to the expiry of his temporary engagement, and Dr. J. W. Munro ceased to be attached to the Institute owing to his resignation of the post of Entomologist to the Forestry Commission. Arrangements for strengthening the Silvicultural staff were completed at the end of the year.

BUILDINGS.

3. The work of the Institute continued to be carried on in the School of Forestry. In order to relieve the congestion to some extent, a house was purchased in Museum Road and has been fitted up to accommodate a portion of the work. The relief afforded, however, is only temporary, and with the expansion of work that has already taken place the need for much more extensive accommodation is acutely felt; staff and students are alike handicapped, the development of work in important directions is prevented for want of room, and serious damage is being caused to valuable specimens and equipment through lack of storage facilities.

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* Part-time Lecturers.

STUDENTS.

4. The number of students attending courses of study for the whole year or for shorter periods was 44 as compared with 22 during the previous year. These may be classified as follows:—

POST-GRADUATE PROBATIONERS.

Colonial Services :	Malaya	3	
	Gold Coast	2	
	Nigeria	2	
	Kenya	1	
	Sierra Leone ...	1	
			Total 9
Indian Services	.. ..		... 5

FOREST OFFICERS ON LEAVE.

Colonial Services :	Nigeria	8	
	Malaya	2	
	Gold Coast	1	
	Ceylon	1	
	Cyprus	1	
	Sierra Leone ...	1	
			Total 14
Indian Services :	Burma	2	
	Assam	2	
	Bombay	1	
	Central Provinces ...	1	
	Punjab	1	
	Forest Research Institute, Dehra Dun ...	1	
	Madras	1	
			Total 9
Private students	... ...		... 2
Research students (Department of Scientific and Industrial Research)	.. ...		... 5
	Total		... 44

5. It is impossible at present to form an accurate estimate of the number of students likely to attend the Institute during the academic year 1926-27, but judging by admissions and by

applications received so far the numbers are likely to be maintained or increased. Students already admitted, apart from special research students, represent such widely scattered portions of the Empire as Australia, New Zealand, South Africa, India, Burma, Nigeria, Ceylon, British Honduras, Malaya, Nyasaland and Cyprus.

INSTRUCTION AND RESEARCH.

6. *Silviculture.*—The Institute has been at great pains to find a fully qualified lecturer for this important subject, but arrangements have now been completed for filling the post, and the candidate selected is to take up the appointment early in the ensuing year. In the meantime the necessary instructional work was carried out by the Director, who lectured on Silvicultural Systems (21 students) and on Tropical Silviculture (23 students), and by Dr. Steven, who gave lectures and demonstrations on nursery practice, together with practical instruction in experimental methods in the field. In connection with the teaching of Silviculture, nine students attended a course of lectures on Climatology by Dr. G. M. B. Dobson, University Lecturer in Meteorology.

7. Training in silvicultural research methods form an important part of the work of the Institute, which derives much benefit from the fact that its staff includes, on a part-time basis, the Forestry Commission silvicultural research officer for England, whose headquarters are at the Institute. The afforestation schemes of the Forestry Commission are now on a very large scale, and the Institute's training in research methods is thus linked up with the wider aspect of practical application. Students are thus enabled to take part in experimental work in operation under actual forest conditions. In order still further to prosecute this work a new experimental garden has been started at Kennington, on the outskirts of Oxford, here work will be carried out jointly by the Forestry Commission and the Imperial Forestry Institute. An extensive series of experiments has been started and students of the Institute personally carry out experimental work with the view of familiarizing themselves with the latest methods of controlled experiment. The problem of reducing afforestation costs is likely to be one of outstanding importance

in other parts of the Empire in the near future, and the training of forest officers in work directed towards this end is a matter of great importance.

8. Two forest officers from Nigeria were deputed to the Institute for a period of not less than one year for special training with the view of undertaking silvicultural research on return to their Colony. This fact is interesting as showing that the Colonies are becoming alive to the importance of having a special staff for the conduct of local research. The officers in question have been given a preliminary training in research methods, and have made a practical study of some of the more recent developments in silvicultural practice on the Continent. In order that they should supplement this training by a study of methods applicable to the tropics, the Director has made arrangements with the Inspector-General of Forests, India, under which they have since proceeded to India to visit the Forest Research Institute, Dehra Dun, and to see the development of silvicultural work under varying conditions in India and Burma. On return to England after an absence of four months they will receive further training in research methods prior to their return to Nigeria to undertake silvicultural research in that Colony. This is an instance in which the Imperial Forestry Institute can be of service in arranging work in other centres and regions in cases where, for geographical or other reasons, students cannot be given the necessary training at the Institute itself.

9. *Forest Management.*—Mr. Bourne gave advanced courses of instruction, both theoretical and practical, in forest mensuration, including the application of the results of recent research on tree form, the construction of volume tables by different methods, the measurement of sample plots, and the conduct of reconnaissance surveys. He also gave a course of lectures on the regulation of the yield with special reference to Colonial conditions, and a complete course of instruction on working plans, including field work, to forest officers on leave who desired to make a special study of this branch of work.

10. *Continental Work.*—Instruction in Silviculture and Forest Management was supplemented by tours on the Continent

during the Easter and Summer Vacations, with the object of making a practical study of the latest developments in European systems. The Director was in charge of parties in France, Germany and Australia, and Mr. Bourne conducted parties in France Switzerland and Czecho-Slovakia and gave instruction in working plans and reconnaissance methods in France. Altogether 31 students attended these tours, the countries represented being Nigeria, the Gold Coast, Malaya, Ceylon, Cyprus and India (including Burma). In the course of these tours visits were paid to the Forest Research Institutes at Zurich and at Mariabrunn near Vienna, and to the Hochschule für Bodenkultur in Vienna. The assistance given by the heads and members of the staff of these institutions, as well as by the various landowners and forest officers whose estates and charges were visited, was a pleasing feature of these tours.

11. With the view of elaborating a scheme for enlisting the co-operation of foresters of world-wide repute, the Director has come to a provisional arrangement with Dr. F. Heske, of the Vienna University staff, whereby he will undertake the organization and conduct of tours and practical work on behalf of the Institute in Central Europe. The Institute will thus benefit not only from the direct services of one of the foremost authorities among the younger school in Central Europe, but also from the liaison thus created with a great centre of forest education and research: it is hoped that this liaison with Vienna may prove to be of mutual benefit. Apart from the question of touring and instructional work, Dr. Heske has also assumed responsibility for keeping the Institute in touch with the latest developments in Central European forestry and for supplying information, literature and specimens, and generally for promoting the welfare of the Institute in every way possible. Direct contact has thus been established with those parts of Europe where some of the most progressive ideas in forestry are to be found, and where some of the finest examples of scientific treatment are to be seen.

12. *Systematic Forest Botany.*—This section was under the charge of Dr. Burtt Davy. The instructional work aims at pre-

paring the forest officer to recognize the more important groups of trees with which he will come in contact, and the principal species of economic value in his own region; practice is also given in identifying the families, genera and species by means of a flora.

(To be continued)

AN EMPIRE FORESTRY CAMPAIGN.

The second annual report of the Imperial Forestry Institute at Oxford, issued yesterday, is a useful supplement to the recommendations on the subject of forestry resulting from the labours of the Imperial Conference. It is a record of work that is already being accomplished. As a centre of training and research the Institute has definitely proved its value, and there is an increasing disposition, especially on the part of forestry officers of the Empire, actual or prospective, to avail themselves of the facilities which it provides. He would be a bold man who would deny the urgency of the need for a wide and practical extension of knowledge in every department of the science of forestry. "A review of the forestry situation throughout the world leads to the conclusion that available supplies of the principal timbers of commerce are rapidly approaching exhaustion." By this uncompromising statement—the opening words of the first appendix to the report of the Forestry Sub-Committee of the Imperial Conference—Mr. Fraser Story exposes in a single sentence the grave danger which threatens not only the Empire but the world. The figures upon which it is based are not open to question. It might be supposed that an Empire with an estimated total forest area of 1,837,000 square miles—about a third of which is at present accessible and marketable—should be able to supply its needs from its own resources. As matters stand, it cannot. A considerable proportion of this area has been depleted by wasteful methods of working, and the most careful management and organization will be required before the waste of the past can be made good.

It must be remembered that nine-tenths of the supplies of pine, spruce, larch, and fir available to meet the huge world

demand for softwoods—which constitute about 80 per cent. of the wood used for industrial purposes—are situated in North America, North Europe, and Siberia. In Europe one-third of the total land area is under forest; but because of the enormous tonnage imported into Great Britain and other countries in the west of the Continent, where the supply of home-grown timber is relatively small, the annual consumption of these softwoods exceeds the amount grown by about 3,000 million cubic feet. For the time being—on account of difficulties of transport, prices, and, generally speaking, of their inaccessibility—the great forests of Russia and Siberia are useless for the purpose of overtaking this deficiency; if these obstacles are overcome the timber which they produce is more likely to be marketed in China, Japan, and even in the United States, than in the west of Europe. It is necessary, therefore, for Great Britain and the rest of Europe to turn to the other chief source of supply in North America. But here again the prospects, and indeed the existing conditions, are the reverse of hopeful. Even from Canada, largely drained of its softwoods by the wood-pulp industry, little is to be expected. Each year fire, insects, and disease destroy an amount of timber as great as that felled by the lumbermen, and only 27 per cent. of the original forest is left. East of Winnipeg a large proportion of the saw-mill timber has already been consumed, and in British Columbia, which produces three-quarters of the total supply of the Dominion, it is estimated that the virgin softwood resources cannot last for more than twenty-five years. In the United States, which consume about half the timber of the world and incidentally provide a market for over 80 per cent. of the trade of Canada in forest products, the story is practically the same. Their original forest area has been reduced by more than one-half, their existing resources are given a life of only twenty-five years, and their imports of timber from Canada increase as the Dominion shipments to Great Britain decline.

It follows, then, that if the supply of soft-woods is to be safeguarded the need for remedial action on the part of the Empire is urgent. Within a quarter of a century, unless both Empire and world timber supplies are largely increased a softwood famine

together with a corresponding rise in timber prices, cannot possibly be avoided. Something no doubt may be done to meet the coming emergency by more extensive use of the Empire's wealth of tropical hardwoods (and perhaps also of other alternative materials) as a substitute for the more readily serviceable type of timber. But these could only be palliative measures of very limited extent. Lord Lovat and the other members of the Forestry Sub-Committee of the Imperial Conference have much larger ideas and schemes in view. Valuable opportunities for concerted action will be supplied by the next two Empire Forestry Conferences, to be held in 1928 in Australia and New Zealand, and five years later in South Africa, on the invitation of the Governments of those Dominions. In the interval, and at the two Conferences, a determined Imperial effort is being and will be made to place the whole question of the national use and development of the Empire's forests on a more satisfactory footing The great aim—the necessity, as the report says—is that all countries should maintain, and extend where possible, their existing forest areas under a system of management based on sustained production of timber. What foreign countries may actually do or not do, though for good or for ill it must vitally affect the interests and future economic position of British people throughout the world, is no direct concern of the Empire's statesmen and forestry specialists. Their business is to take a far-sighted view of the possibilities of silviculture within the King's Dominions here and overseas, and to strain every nerve so to administer the timber resources of the Empire as to make it as nearly self-supporting as may be, more especially in the supply of softwoods. As one means towards this end the Sub-Committee have decided to refer to the Foresty Conference of 1928 the question of establishing an Imperial Forestry Bureau, to act as a clearing-house for information While recognizing the usefulness of the Standing Committee on Empire Forestry, the Imperial Forestry Institute and the Empire Forestry Association, and also of the research and training work which is being carried on by the Imperial Forestry Institute at Oxford, as well as in Montreal, Vancouver, Pretoria, the University

Colleges of Auckland, Wellington, and Canterbury in Western Australia and Victoria, and at Dehra Dun and other stations in India and Burma they express the opinion that there is much need for further development and for co-operation between the various organisations engaged in research into forest products. They consider also that there is a distinct possibility of developing schemes of settlement in connection with State Forestry and afforestation—on the lines already adopted in this country by the Forestry Commissioners—and they have communicated their views on this subject to the Sub-Committee of the Imperial Conference on Overseas Settlement. The whole report, together with its appendices, conveys the idea that this Empire campaign for a proper system of forestry, built up on the organizations already in existence, will be a solid and intelligent reality.

(*The Times*, November 30th, 1926.)

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SAL GERMINATION IN THE UNITED PROVINCES.

In a brief editorial in the *Indian Forester* for September 1926 mention was made of the bumper seed year for sal in the United Provinces. It has now been possible through the courtesy of the Conservator of Forests, Working Plans Circle, United Provinces, and the Divisional Forest Officers of the various sal divisions to collect the following information :—

Generally speaking throughout the Eastern Circle and in the Haldwani and Ramnagar divisions of the Western Circle practically all the sal seed was blown down from the trees in the third week of June. As proper monsoon conditions were not established until about the middle of July there was practically no germination and the seed was nearly all wasted.*

Apparently, however, further west this was not the case. The Divisional Forest Officer, Kalagarh, reports that although large quantities of seed were shed early and the monsoon came abnormally late a sufficient quantity of seed still remained on the trees and that sal regeneration was fairly abundant and healthy throughout the division. The Divisional Forest Officer, Lansdowne, also reports excellent germination in the higher foot hills and in the Lansdowne range of his division. In Dehra Dun division germination has been abundant everywhere and early in November there are large quantities of healthy seedlings to be found in most places.

*Since writing the above the Conservator of Forests Western Circle, informs us that in the Ramnagar division there is in some places a considerable amount of fresh regeneration,

As monsoon conditions were not fully established until the middle of July and ceased in the middle of September the establishment period was a very short one. A very high percentage of the seedlings have only two leaves and most of them have little hope of survival. There are, however, a considerable number of seedlings with three or more leaves which should eventually become established.

In anticipation of the seed year considerable areas were burnt departmentally after the sal leaf fall in April 1926. It is rather early yet to say anything definite about the results but on the whole the seedlings do appear to be more healthy and are certainly more numerous in the burnt areas.

In the unburnt areas also many seedlings can be found but a very large number of these have roots which have wormed about among the dead leaves and failed entirely to penetrate the soil. A slight pull is sufficient to bring these seedlings up with their roots, terribly misshapen, quite intact. One area in Thano range (compartment No. 20) is especially noteworthy. This is an area of well stocked sal forest of good quality with, formerly, a dense *Clerodendron* undergrowth which had previously been successfully fire protected for many years. This was burnt in April 1925, and again in April 1926, a light leaf fire resulting.

It is clear that these two burnings have been insufficient to make much difference to the soil, and seedlings have entirely failed to persist. Throughout the area can be found little dead stems four to six inches high, the roots of which have (by December 1926) entirely rotted away. It is particularly noticeable that in this area the only seedlings to be found, and these appear quite healthy, are in small open patches where there is a light grass growth.

The year was also a very full seed year for *sain (Terminalia tomentosa)*. *Sain* seedlings are found everywhere (near seed bearers) on bare soil, but their absence in unburnt forest of even very medium cover is striking. There is an area near Lachiwala in which the stock, density and soil is precisely similar on two sides of a road. One side of the road was burnt and the other not. In the burnt area there are numerous *sain* seedlings, on

the other unburnt side there are no *sain* seedlings whatever. This has been borne out also by careful observation in other places. It would appear that *sain* is even more intolerant of masses of decaying leaves than sal and this probably accounts for the almost entire lack of *sain* regeneration in our too successfully fire protected forests.

The Imperial Silviculturist has kindly sent the following note about the collection of seed, sowing and development up-to-date in the sal sowings made by him at the Forest Research Institute, Kaulagarh :—

Except for a little unripe or imperfect seed none had fallen on June 21st nor yet on the 26th when the sal forests nearest the Research Institute were visited. On July 4th much of the seed appeared ripe on the trees and was easily dislodged by shaking. As it was probable that a single storm would bring down the whole crop, and in view of the delayed monsoon, such storms were to be expected, a lorry load of seed was collected on July 6th, brought into Kaulagarh and spread over 2″ of sawdust on the concrete verandahs of the new institute and lightly watered twice daily. Nearly every tree had a heavy crop of seed but there was a very striking range of size in the seed. Circumstances did not permit a very close examination of the relation of the average size of seed to the age, dominance or vigour factors of the individual tree, but the general impression gathered was that, as with orchard fruit, the more thickly the branches were loaded, the smaller was the average size, except that such branches of an over-loaded tree as were not so fruitful, still had small seed. In selecting trees for seed collection the temptation to collect these big crops of small seed was resisted

The rains broke on July 7th, and two days were required by the cultivators to get far enough with their double ploughing to allow sowing of the sal to be commenced The fruits stored as above described since the 6th were put out in lines between July 10th and 12th; they had nearly all germinated, the radicle being pushed out ¼″ to 2″ or more by the lengthening cotyledonary stalks and care was taken to put them in the right way up.

Another expedition was made to the forest on July 13th when there was still $\frac{2}{3}$ to $\frac{3}{4}$ of the crop on the trees, the rain having been unaccompanied by wind. This lot of seed was spread on the ground in the sowing area and got out in the next four days, sowings being finished on July 16th. On July 24th there was still quite an appreciable amount of seed on the trees, possibly $\frac{1}{20}$ to $\frac{1}{30}$ of the original crop. Green ungerminated seed was collected and sown for observation some of it after being kept till the 27th on a stone verandah (without sawdust).

The procedure in the *taungya* areas was for the cultivator to plough once, and then cross-plough: he then sowed his crop, in this case *charri*, and levelled the field with the **merha*. Lines were pegged out 8 feet apart and the sal seed sown in a double line with 3" × 4" spacing. The seedlings were weeded twice during the monsoon, the first time being rather late as not a few seedlings, usually in patches where moisture loving plants like the *Cyperaceæ* were most abundant appeared burnt, showing red patches on the leaves. The precise cause of this injury which sometimes killed the seedlings was not determined, but it was equally apparent on the *charri*, and the cultivators ascribed it to the *Cyperaceous* weeds. The dates of the weedings over the 8 acres sown were 12th to 21st August and 22nd to 30th September.

Germination and plant per cent were excellent throughout the area sown, and some 60 per cent. have survived all forms of injury including those of unskilled weeding, to the end of November. In particular, it must be noted that so far there has not been found a seedling dead from the drought prevailing since September which is in very marked contrast indeed to what one finds in the forest even in shaded places with good soil (everywhere 30—40 per cent. at least have died off during the month); this is perhaps all the more noteworthy in view of the complete exposure of the *taungya* sowings. At the conclusion of the sowings several bags of surplus seed were sown very thickly over some roughly dug strips; only one weeding

* A clod crusher.

was done after some 'burning' was noticed, but the average appearance of these seedlings now seems rather better than the lines. It seems that freedom from the shade of the field crop more than balances the drawbacks of overcrowding and lack of weeding and consequent soil working. Investigations have been made with a view to co-ordinating the above and below ground portions of the seedlings both in the forest and the fields and to connect this with the chances of survival of the individual seedling. The data have not yet been worked up, but it appears that at least this year, the development of the above ground portions was not greatly affected by the root system, though possibly the development of 5 or 6 small leaves instead of fewer and larger ones, indicates a feeble root system. Examination of a considerable number of seedlings carefully washed out of the soil gave interesting results which will be written up later. In the majority of cases the root tip had evidently got into difficulties at a depth of about 4" which approximately agrees with the depth the local ploughs reach, the tip root then usually died or at least ceased growth and lateral roots were developed to a varying degree and in a few cases one of these found its way through the difficult zone, replacing the lost tap root. When the radicle or tap had got down direct, it was often found to have reached a depth of 30" or more, the secondary tap roots may reach about 20" depth whilst the rest remain in the top 6 or 7 inches. The results of last year's sowings, assuming the conditions were the same, indicate that many of these last must have survived, but it would seem doubtful if they will survive a year with poor winter rains though the complete absence of drought mortality so far gives ground for hopes. Seed bed sowings at Chandbagh to test plant per cent for the different lots of seed gave throughout poorer results than the field sowings. My absence on tour part of the time precludes my giving an explanation of this. There is very little difference to be seen—hardly outside the limits of experimental error—between the different lots which included :

(1) Seed collected on July 4th kept watered on a concrete verandah without sawdust till July 18th.

(2) Seed collected on July 6th and kept watered on a concrete verandah with sawdust till July 12th.

(3) Seed collected and sown on July 13th.

(4) Seed collected on July 24th and sown on 25th.

(5) Germinated seed collected off the ground on 24th and sown on 25th.

(6) Seed collected on July 24th, stored as (1) and sown on 27th.

It must surely be the first time that sal seed in the United Provinces has been collected off the trees and successfully sown as late as July 24th.

W. A. BAILEY, I.F.S. &

H. G. CHAMPION, I.F.S.

HOPLOCERAMBYX.

I do not claim to be an expert in entomology but I have had a good deal to do with the carrying out of remedial measures to combat with this pest both in Dehra Dun and Kalagarh divisions. In the latter division the attack is most intense in the furthermost hills and at a distance of 25—40 miles from the nearest railway station or market by jungle road. The remedial measures are based on the removal of the wood while the larvæ are still embedded in the tissue and before the beetle emerges and the destruction of the refuse. In the Dehra Dun division, with its better communications, the extraction of the wood by purchasers is a comparatively easy matter but this is not the case in Kalagarh and similar localities. In the case of Dehra Dun I remember that figures were given in this journal showing the small value of insect riddled trees due to the higher cost of conversion owing to waste and the lower market price of the timber. These factors combined with the long lead to the railway almost entirely preclude the complete extraction of this class of timber in Kalagarh through purchasers. Experience has shown that in this latter locality purchasers will extract the less riddled timber leaving at least two-thirds as litter in the

forest to be destroyed by departmental agency. Various attempts have been made to compel purchasers to collect the litter and even to fire it, but with little success. The profit from this class of timber is so low that any extra cost entailed by these obligations involves the contractor in loss. The profit under free working does not amount to more than 5 annas a cubic foot, a figure which is even disputed. Consequently the greater part of the remedial measures have to be done departmentally.

The attack was first noticed late in 1924 but it was not until the following year that it reached any serious proportion. Nineteen compartments aggregating 9,800 acres were enumerated and of these, 5 compartments showed an intensity of attack of from 3 trees to 1·1 trees per acre and the remaining compartments an intensity of from ·15 to ·9 per acre. Generally speaking the compartments in the west were more affected than those towards the east of the area. In calculating the intensity the mortality from previous attacks was included, also all trees showing excretions of sawdust. In 1925 one compartment, showing the greatest attack, was subjected to remedial measures: all trees were felled and the refuse burnt by a ground fire in May and heaps not satisfactorily dealt with were treated individually. In the same year another badly attacked compartment was experimentally dealt with by the use of the trap logs.

In the autumn of 1925 eleven of the western compartments aggregating 6,016 acres were re-enumerated to include the current attack and these showed an increase ranging from 15 to 81 per cent: the greatest increase was found in the western compartments rather than those in the east. Here again, all trees showing excretions of sawdust were enumerated. These eleven compartments were sold and felling operations commenced in November 1925 which were carried on up to March 1926. Exploitation was very incomplete but the western compartments were worked more thoroughly than those in the east. Departmental collection and burning of the refuse was started in April 1926 and continued until the break of rains. Owing to the hot season and scarcity of labour it was only possible to deal with 5 compartments. During this period the refuse of 1,273 trees was logged,

stacked and burnt but it was found impossible to deal with all trees left by the purchaser, so 1,674 trees were left standing, the refuse of 259 trees was stacked but not burnt, and the refuse of the remaining 468 trees was left lying in the forest, by this time the area of intense attack had extended further eastwards down the Mandal valley to its junction with the Ramganga where the maximum intensity of attack amounted to 1·9 trees per acre. In the spring of 1926, enumerations were carried out in three compartments in the centre of the attack zone, not previously subjected to remedial operations: these showed an intensity from 1·1 to 1·4 per acre including the mortality of previous years and trees showing excretions of sawdust. In one of these compartments trap log experiments were carried out. It is too early yet to give any figures for the current attack but there is sufficient evidence to show that the epidemic has abated in the western section but is showing signs of greater intensity in the extreme east and centre.

The following is the direct and indirect cost of these operations:—

	Rs.	a.	p.
Expenses on all operations referred to above	4,260	0	0
Revenue received by sale of produce	3,720	0	0
Loss ...	540	0	0
Indirect loss on timber sold at reduced rate, probably	11,300	0	0
Total loss ...	11,840	0	0

With regard to the remedial measures carried out I gather:—

(1) That no deductions as to incidence of attack can be made from the enumeration figures, as apart from including many trees on which attack subsequently failed, the first figures include dry trees of past attacks in unknown quantities.

(2) That the figures for the area felled and burnt in 1925 probably bear much the same ratio to the 1924 attack figures.

(3) That owing to many trees being felled which subsequently recovered from attack, there was a large waste of good material.

(4) That marking in October is too early as the full effect of the attack is not known until late January or February.

(5) That the amount of refuse left was so large as to vitiate the effect of the remedial measures.

(6) That no deductions were possible from the trap logging experiments of 1925, the figures for this compartment being in much the same ratio to the 1924 attack as in other compartments.

The area of intense attack is confined to a definite strip of forest running due east and west along the northern boundary of the division between the Palain and Ramganga rivers and comprising the valleys of the Haldgaddi and Mandal. Although the forests are partly open to rights, the forests are well stocked and in places congested except near villages where rights are freely exercised. The last fellings to take place in these forests date from 1893 to 1911, the earlier fellings covering the areas open to rights: exploitation at these fellings appears to have been incomplete judging from the number of old hammer blazes still traceable on trees. These valleys are very badly formed for the free circulation of air currents and it is here that the worst frosts of the division occur and which have undoubtedly affected the growing stock as evidenced by the number of trees showing multiple leaders. The altitude of the tract ranges from 3,800 to 1,500 feet and sal occurs throughout. A large part of the area was burnt in the incendiary fires of May and June 1921. Regeneration in many of the compartments, especially those burnt in 1921, is satisfactory.

It is definitely known, and proof in this division is not wanting, that *Hoplocerambyx* prefers trees that have been weakened from various causes such as lopping, girdling, fire, etc., and that the presence of litter favours the spread of attack. Most of the conditions favouring the beetle occur in the valleys referred to: much of the stock is over mature, many unsound trees left by former purchasers have been kept, the forests were injured by fire in 1921 and frost has weakened the stock.

I submit that the remedial measures adopted, so far as outlying forests are concerned, are fundamentally wrong and what is required is greater attention to the general sanitation of

the forest if it is possible to use such a term

The protective measures that seem necessary are as follows :—

(*i*) Avoid retaining trees that are weak from over maturity or other causes. Probably 4 feet girth is the maximum health dimension for trees growing on the upper hills.

(*ii*) Avoid weakening causes such as fierce fires in the hot weather.

(*iii*) Avoid litter. The insect is undoubtedly attracted to felling areas and cultural areas. The early burning so often advocated for the regeneration of sal would probably render the litter less attractive to the insect. It might also serve some purpose to leave a certain number of *girdled trap trees and trap refuse* which could be thoroughly burnt in the following season. These trees and refuse should be conveniently placed for burning as it is found that the destruction of the refuse by bonfires weakens the surrounding trees and favours the spread of the attack. The heat generated by a large bonfire is so great that it may affect trees up to 30 yards distant.

(*iv*) Frost is undoubtedly a cause of much unsoundness of timber in Kalagarh. Very little has been done in devising remedial measures against frost. It is known that a dense tree crop by its retarding effects on air currents enhances damage by frost and this possibly accounts for the absence of the pest from the forests on the north bank of the Mandal river which are more open than the forests on the south bank.

I cannot help thinking that the outbreak in Kalagarh is largely due to incomplete conversion resulting in the retention of a large number of unsound trees and litter Complete conversion depends on good communications but it is not possible to do much in this direction until the long projected Kalagarh Railway becomes an established fact. The cultural operations following the main fellings are limited largely by financial considerations and so trees, which purchasers leave as being unprofitable to exploit, are often left in the subsidiary operations when there is nothing else to take their place or when their presence is doing no silvicultural harm to the adjacent stock. I think that unsound stock should be removed. Some three years ago I published figures

in the *Indian Forester* showing the alarmingly high percentage of unsound timber in Kalagarh. I forget the figures but our actual outturn is approximately only half what our volume tables would have us expect. The removal of this unsound stock is desirable and I am not at all sure that *Hoplocerambyx* is not a blessing in disguise in some places, doing for us what we ought to have done ourselves. It has been said that our remedial measures were so incomplete as to vitiate their effect, if this is so, I can only attribute the reduction of the pest this year in the western compartments to the exhaustion of favouring material. I am not alone in thinking that in some compartments the attack has done a great deal of good, replacing useless stock by a fine crop of saplings, although I admit at a high cost.

The remedial measures at present advocated are difficult to execute on a large scale as our labour is mostly imported, local labour being only casual. If fellings are delayed until February I doubt whether any purchasers would come forward except as a means of finding work for sawyers not fully occupied on adjacent works and I doubt whether sawyers would work after April. Then comes the difficulty of the disposal of the refuse at a time when labour is anxious to get to the Hills. Apart from these difficulties the burning of refuse has been found to be a positive danger encouraging the spread of the beetle. These measures possibly might be applied to sporadic cases of attack but their application under epidemic condition is impracticable. This season we are isolating the epidemic zone by dealing with all sporadic attacks on these lines but even in these cases bonfires are a danger; however, by doing this work earlier in the season it is possible to reduce the danger.

In the area of intense attack the difficulty is to devise sufficiently practical methods and it is greatly hoped that the trap log experiments will prove satisfactory.

It would be interesting if one could be supplied with data showing the relative effect of remedial measures adopted in the Thano forest of Dehra Dun compared with the effect of allowing the pest to run its course in the bordering private forests. At present I do not altogether share the alarming views of those

who hold that unless attacked material is completely disposed of we must expect such an increase in the pest as will almost wipe out the sal forests.

Lansdowne, U. P E. BENSKIN, I. F. S

31st December 1926

FURTHER OBSERVATIONS ON HOPLOCERAMBYX.

The Editor of the *Indian Forester* has kindly permitted me to add a few observations on the subject of the foregoing paper, which in view of its increased importance in recent years, should be of interest to all forest officers in sal divisions. Already a considerable diversity of opinion exists on several of the questions raised, but space is not available to deal with more than one or two.

1. *Liability of the sal to attack by Hoplocerambyx.*—With regard to the condition of the tree that renders it most liable to attack various views may be instanced. In the Central Provinces, where the present epidemic has involved five or six million trees in South Mandla division alone, it is considered that *Hoplocerambyx* chooses the healthiest and largest trees, particularly those with crowns standing well above the surrounding growth; the extension of the attack to trees of smaller girth is regarded as in the nature of an overflow. In Forest Bulletin No 70, recently issued, Mr. Atkinson concludes that there is no satisfactory evidence that the beetle normally confines her attention to sickly trees and only under pressure of numbers attacks green healthy trees; he draws attention to the heavier proportional attack on the biggest trees and explains it by an ingenious hypothesis as to the female's powers of selection.

In the United Provinces the attacks in Lansdowne and Kalagarh have been attributed to loss of vitality due to the fires of 1921 (Annual Progress Report for 1925), while it is further suggested (Annual Progress Report for 1926) that the absence over a long period of a cleansing fire may have indirectly produced borer-attacks. Mr. Benskin assures us that proof is available in Kalagarh that *Hoplocerambyx* prefers trees weakened

from various causes such as lopping, girdling, fire, etc. In the United Provinces a very high proportion of the attacked trees are classed as hollow; in the Central Provinces hollow trees and particularly "pipes" are regarded as unfavourable breeding-material.

Divergent as these views appear each can be supported by judicious documentation. The fact that there is more than a grain of truth in each serves to show the complexity of the problem.

An examination of the percentage-distribution by girth-classes of trees enumerated as attacked shows that there is a considerable variation in the intensity of the attack on the several girth-classes in different localities and also in successive years.

The following data show the distribution of the attacked trees over large blocks at the beginning of an epidemic in girth or diameter-classes expressed as a percentage of the total number attacked:—

Percentage per class of total number of trees attacked.

	1½'—3'	3'—4'	4'—5'	5'—6'	Over 6'	
South Mandla & Balaghat, C. P., 1925-26	8—51	20—40	15—34	5—19	4— 1	Based on 13,628 trees.
	0"—12"	12"—16"	16"—20"	20"—24"	24" & over	
Kalagarh and Lansdowne, U. P., 1924—26.	17 to 32	22— 33	20—30	11—19	4—15	Based on 12,670 trees.
	0'—3'	3'—4½'	4½'—6'	Over 6'		
Thano, U. P., 1916—18	37—59	30—39	9—19	2—5		Based on 45,692 trees.

When small units of area (compartments) or small numbers of trees (under 1,000) are taken the range of variation is still

greater. It should be noted that the *over 6'* or *over 24"* classes represent a combination of several size-classes in one and that the *under 3'* or *under 12"* classes include trees below the dimensions suitable for the successful development of larvæ.

The percentage-distribution by size-classes of the attacked trees is obviously influenced, among other factors, by the constitution of the growing-stock. Unfortunately recent growing-stock estimates of forests in which *Hoplocerambyx* attack occurs are rarely available. In making use of estimates made ten to twenty years ago the error introduced by subsequent changes in the constitution of the crop must be borne in mind.

Using old working plan estimates the relative intensity of the attack on the growing stock available in each size-class may be expressed by the percentage-attack : percentage growing-stock ratio. For comparison the attack on class 3'—4' or 12"—16" has been reduced to unity.

Relative intensity of attack per class.

	2'—3'	3'—4'	4'—5'	5'—6'	Over 6'	
Three sample plots in South Mandla and Balaghat, C.P., 1925-26	0·75	1·0	2·7	3·7	8·0	Based on 2,071 trees.

	12"—16"	16"—20"	20"—24"	Over 24"	
Seven compartments in Kalagarh, U. P., 1924-26.	[illegible]	2·6	3·6	5·8	Based on 1,675 trees.

These index-figures show that at the beginning of an epidemic the attack on the larger trees is relatively heavier than on the smaller trees; (the data recorded in Forest Bulletin No. 70 show a still higher divergence).

When we take the later stages of an epidemic and compare the intensity of attack with a concurrent growing stock estimate

a different picture is revealed. Thus, for Thano 1922-23 at the close of the epidemic the index figures are as follows :—

	8"—12"	12"—16"	16"—20"	20"—24"	Over 24"	
Thano, U. P. 1922-23.	1·15	1·0	1·03	1·36	1·02	Based on 7,036 trees

From which we are led to infer that at the conclusion of an epidemic outbreak of *Hoplocerambyx* the intensity of attack is the same throughout the crop and the liability of individual trees to attack is governed primarily by the laws of chance.

In the foregoing discussion leaving out of consideration the errors due to faulty selection and omission we have adopted a common assumption that the figures for the trees enumerated as insect-attacked represent *all* the trees on which the borer has laid eggs. In point of fact they do not. The data are really an indication of the mortality or powers of resistance of the sal under borer-attack and are complicated by other factors among which climate is dominant. In an earlier paper (*Indian Forester*, 1921, pp. 69—76) I pointed out that the proportion of sal trees killed outright bore no fixed ratio to the total number attacked but that it could be correlated with the total annual rainfall.

There is abundant evidence that the power of resistance to the establishment of *Hoplocerambyx* larvæ is highly developed in sal. I consider that the healthy tree can protect itself against all but a mass-attack. Recent analyses have shown that larvæ are able to kill only that part of the tree in which they are concentrated above a certain strength; below that strength in one and the same tree-trunk the tree kills the larvæ. If we adopt a mechanistic theory for the activities of the borer and suppose that oviposition occurs throughout the crop (excluding saplings and small poles) in direct proportion to its constitution it is logical to conclude that the higher rate of mortality shown under certain conditions by the larger trees is evidence of their smaller powers of resistance, *i.e.*, they are not in a healthy condition. When an

epidemic has cleared out the weaker individuals in the crop the mortality reverts to a uniform degree.

With regard to unhealthiness as a predisposing factor we have evidence in Sainkot Block of Dehra Dun division where control measures have reduced the borer-population but trees still continue to die off; many of these trees have not been attacked by *Hoplocerambyx*.

Mr. Benskin's conclusion that *Hoplocerambyx*, if not "a blessing in disguise," is at least an indicator of something wrong silviculturally deserves serious consideration. The application of these theories is, however, much handicapped by the want of silvicultural statistics.

2. *The effect of fire.*—The effect of fire protection or fires on the abundance of *Hoplocerambyx* can be regarded at present only in the same light as Darwin's classic case of the effect of old maids on the pollination of clover During epidemics the natural control of *Hoplocerambyx* by parasites and predators is very feeble, but is undoutedly bound up with the abundance of other heart-wood borers, particularly *Aeolesthes holosericea*, which in turn are affected by the presence or absence of fires.

Fierce fires or bonfires may affect the liability or resistance of the sal to attack by borers. Within a few yards of a bonfire the base of the bole may be charred or the cambium killed by radiation. Such trees are attacked by *Hoplocerambyx* above and not in the killed zone. The scorching of the foliage is apparently not serious around bonfires or on the edges of the burned grass lands. Beyond a few yards distance heat does not directly injure the trees. On this point I venture to question Mr. Benskin's statement that "the heat generated by a large bonfire is so great that it may affect trees up to 30 yards distant." In forests where there is a high beetle population a bonfire acts as an attraction or concentration centre, and a relatively higher proportion of trees is attacked over as much as an acre round such foci, but the attacked trees are irregularly distributed. So far from considering the burning of refuse "a positive danger encouraging the spread of the beetle" I would

term it a useful means of *restricting* its spread and suggest that in conjunction with trap-trees it could be turned to good purpose. Early burning scarcely affects the question since the refuse of early fellings (November to February) is of little danger as breeding material.

3. *The Control Policy.* -Mr. Benskin states on page 197 that "the remedial measures adopted so far as outlying forests are concerned are fundamentally wrong." If this sentence is to be taken literally I must disagree, for a remedy which attempts to reduce the probable damage in the next year by destroying the pest (whether by exploiting or by burning the attacked timber) appears to me to be fundamentally sound. But in his following paragraph he advocates protective measures which are actually measures designed to *prevent* epidemics—the implication being that it is a fundamental error to allow the pest to get out of hand to such an extent that desperate remedies have to be adopted. With this every forester will agree excepting only those who have greater faith in Nature than in human intervention.

These protective measures do not differ in principle from those discussed in Forest Record, Vol. XI, viii, pages 27 and 36. "It is self-evident that good silviculture is a preliminary to control measures and that clean utilisation should follow" (*loc. cit.*) Under *endemic* conditions it is the presence of non-resistant trees that determines whether a local increase of the borer (derived from felling-refuse, windfalls, etc., and favourable climatic conditions) will or will not spread further. Short-cycle improvement fellings to remove borer-killed trees before the following rains and special action where the infestation is higher than one per cent. of the growing-stock have been advocated. To this may now be added the rule that such protective fellings may be most profitably adopted in the winter following two seasons of exceptionally high rainfall.

As Mr. Benskin points out, the possibility of enforcing the remedy advised by the Forest Research Institute (*i.e.*, burning the attacked trees) depends largely on the labour question. But even under the most adverse conditions considerable headway can be made. The organisation of the felling, stacking and

burning gangs devised by Messrs. Muir and Maitland in South Mandla is an admirable model. Work is directed to the areas of heaviest infestation in the best quality sal forests and a rotation of three visits allows the inclusion of all late deaths. In areas of scattered attack no work is done; and thereby the scheme differs from Mr. Benskin's remedy for the small outbreak in Kalagarh, where he is isolating the epidemic zone and dealing only with sporadic attacks. In South Mandla it is hoped to deal with two lakhs of attacked trees before the rains of 1927. In Balaghat Mr. Anthony expects to reach a still higher proportion, —50,000 out of an estimated attack of 411,000 trees.

It may be accepted that the labour-supply under modern conditions is always insufficient to carry out a control measure on an ideal scale, *i.e.*, to wipe out an epidemic in one year. The secondary objective is then to destroy the largest number of borers for the labour and expenditure involved.

In many of the control operations against *Hoplocerambyx*, that the Forest Entomologist has been privileged to study, their efficiency has been much reduced by faulty selection of the trees. Unless the selection of insect-attacked trees is carefully supervised much labour is absorbed in converting or burning green boles containing no borers, and trees likely to recover may be unnecessarily sacrificed. *Written or verbal orders to forest* guards and jemadars in charge of felling gangs are liable to misinterpretation; it is possible that picture-diagrams would be more satisfactory.

One of the reasons why *Hoplocerambyx* damage appears to have increased of late years may be found in the wholesale marking of lightly attacked trees. In Forest Record, XI, viii, page 28, para. 5, ii (*c*) (*d*) it is advised that they should be left standing.

With Mr. Benskin's last sentence I am in complete agreement. *Hoplocerambyx* will not wipe out the sal unaided, but it will be materially assisted by control measures that are not carefully controlled.

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Forest Entomologist.

FOREST ADMINISTRATION.

(Lecture given to the senior students of the Rangoon University, by H. W. A. Watson, Chief Conservator of Forests, Burma.)

(Continued from pp. 131—141, "Indian Forester" for March 1927.)

Demarcation and Survey.—As soon as a reserved forest is notified the boundaries have to be demarcated and the area has to be surveyed

The boundaries are demarcated by posts linked up by blazed trees and with boards at intervals. Where the boundary is a natural one, such as a river or a main ridge, little, if any, demarcation is required. Where it is an artificial one across country the posts are placed close together and demarcation has to be especially carefully carried out where there is danger of encroachment The total length of outer boundaries of reserved forests is a little less than 23,000 miles or about 65 times the distance from Rangoon to Mandalay.

An accurate map is absolutely necessary for management and all survey work is carried out by the Survey of India. The scale of 4" = 1 mile is the standard scale for forest maps, but some of our less valuable reserves are surveyed on the 2" = 1 mile scale. A 3" = 1 mile scale was accepted for mapping the result of the aero-photo survey of the Irrawaddy Delta as this corresponded approximately to the scale of the photographs which were taken from the seaplanes at a height of approximately 10,000 feet above the forest. Of the 31,000 sq. miles of reserved forests, 20,000 sq. miles have been mapped on a scale of 2" to a mile or larger; 8,000 sq. miles are covered by topographical maps on the 1" = 1 mile scale and 3,000 sq. miles are unmapped.

The 4" = 1 mile scale is the minimum scale suitable for detailed field work. It is large enough to show all essential features and allows of a position being located to within 15 yards of accuracy. The possibility of accurate location decreases with the scale, partly because the survey is rougher and partly because there is not enough paper surface to show details. It is difficult to locate a position within 50 yards of its true position on a 2"

map and on a 1" map it is impossible to locate anything but main features.

Forest Management.—As already stated the science of forestry has for its object the treatment of forests in such a manner as to ensure the continuous production of timber and other forest products. Forest management proper can only be undertaken over and set aside for the purpose. Outside our reserved forests we can to a certain extent regulate the felling and extraction of teak but conditions are such that we can do nothing to improve these forests and with few exceptions their disappearance as a source of supply of other than petty domestic wants is inevitable.

Our past management has centred round teak and the outstanding value of teak must always cause it to be a dominant factor in our management. It is only within the last 20 years that the depletion of the accessible areas of our unclassed forests has rendered it necessary for us to organise the management of our reserved forests to allow of produce other than teak being worked.

The basis of all forest management is system and a strict adherence to the principle that it is unsafe to remove more from a forest within a given period than can be reasonably expected to be replaced by growth within that period. System implies that a forest must be sub-divided into compartments and that working must go over these compartments on a regular plan.

When teak was the only produce demanded from our reserved forests the management plan was a simple one. The demand for other produce has now rendered more complicated plans necessary. As a preliminary to organising the forests to supply this produce they have to be carefully examined and classified as regards accessibility and the possibility of opening them up by roads. When the demand exists or is likely to arise the most accessible areas are set aside with the main object of meeting the requirements of the local people including the local traders. This is essential. The people living on the borders of the forest must be kept happy and contented and their sympathies must be enlisted for the protection of the forest. Unless, therefore, their claims are considered first there will be trouble and management

will be difficult if not impossible. There will be constant thefts and damage. The first point, therefore, is to make provision for the wants of the local people and the easiest areas must be set aside for this purpose. Areas not required for the supply of the local people are available for working by the larger extraction agencies who can afford to put money into opening up the forest.

Protection and improvement must go hand in hand with extraction. Useless trees must be cut out and climbers interfering with the growth of trees must be cut. This is not enough, however, where the demand is heavy and forests have to be cut down and planted up to meet this demand. Where the bamboo growth is heavy planting has proved the only economical method of getting an adequate tree crop on to the ground. Our planting is done by the *taungya* cutter who puts down our tree plants with his crop of paddy and is paid by results after he has reaped his crop.

In addition to regulating extraction and improving the forest growth management is concerned with the construction and upkeep of roads, the housing of the staff the upkeep of boundaries and all items necessary for the proper maintenance of the forest estate.

The plan of management for each unit of area is prepared by a special staff who examine the forest in detail and prepare a plan, the working plan, to regulate all matters concerned with the management for a fixed period. These working plans are carefully scrutinised by the Conservator, Working Plans, and sanctioned by Government before they are adopted. They are revised periodically and brought up to date. While they are in force the results of the work are reported in control forms each year to the Conservator, Working Plans who is responsible for the audit of these forms against the prescriptions of the working plans and for drawing attention to all deviations from the working plans.

A working plan is compiled in two parts Part I summarises past history and the results of past working. Part II lays down the future management for a period of years. For purposes of system and control the forest is divided into suitable units of area, usually about a square mile in size, called compartments.

Each compartment is given a number and demarcated on the ground. All operations are fixed with reference to numbered compartments. The yield is calculated on the number of mature trees that are estimated as a result of countings to be present in the forest and the time required to replace them. This latter is usually based on the rate of growth of teak which can be assertained with accuracy by counting rings on stumps of trees felled. Each ring represents a year's growth. The compartments from which extraction may take place each year are laid down as are also the rules under which trees may be marked for felling and where possible the number of trees that may be felled each year. Similarly the planting operations or other works of improvement that must follow felling in each compartment are prescribed. The upkeep of roads is prescribed as are also the new roads to be constructed with the object of facilitating extraction. In fact the working plan considers and prescribes all measures necessary for the upkeep and consolidation of the Forest Estate from the maintenance of boundaries to the housing of the staff and winds up with a budget showing the anticipated financial results of the management.

Perhaps a brief sketch of how enumeration and calculation of the growing stock is done may be of interest. Sample plots are selected on the 4" = 1 mile map with simple natural boundaries such as streams or ridges. They vary in size from about 50 to 120 acres. An enumeration party consists of either two or three headmen each with three assistants. The senior headman lays out the boundaries of the sample plot on the ground by *blazing trees lightly at intervals on the ridges and cutting* occasional twigs or undergrowth to mark the streams. The trees inside the plot are measured by callipers at breast height and classified by species and diameter classes by the assistants who call out each tree and diameter class as they apply the callipers while the headmen book the result. The line of enumeration starts along a boundary each measurer working a little behind the next man and lightly blazing the tree measured on the side towards him. When the top of the plot is reached the party follows back keeping up to the strip

measured and so on till the plot is finished The area counted is recorded in the field map and the results of the counting in the register of sample areas The growing stock of each compartment is calculated by simple proportion.

Finance.—During the five years ending 1918-19 the forest revenue averaged 114 lakhs, the expenditure 52 lakhs and the surplus 62 lakhs. During the five years ending 1923-24 the figures were. Revenue 188 lakhs, expenditure 84 lakhs and surplus 104 lakhs

The financial position of the Forest Department, thanks to the forethought which introduced forest conservancy in time, is exceptionally good though whether the surplus of the past six years will be maintained is doubtful. We have lost large areas of forest land through the extension of cultivation and so far as teak, our main asset, is concerned, we have practically worked through our surplus stock of old trees and must depend for the future on the new growth put on to replace them. We are, however, in a very favourable position compared with some other dependencies of the British Empire where forest conservancy was introduced too late to save the forests and as a result heavy expenditure has to be incurred to replace them.

We have even an illustration of the result of unregulated use at our own doors. Less than 40 years ago Moulmein was still the main centre of the trade in teak and dealt with more than half the output handled in the province. To-day Moulmein does not handle one-third of the quantity of teak that was handled there 40 years ago because the people of the country beyond the frontier from which the supplies came allowed their forests to be exploited without proper management.

A criticism recently levelled against the Forest Department in Burma is that the revenue has not increased in proportion to the expenditure and it has been said that the work of the Forest Department *would afford greater cause for satisfaction if* it showed an increasing revenue combined with an almost stationary expenditure. Such criticism might be justified within limits if forestry connoted merely the exploitation of the products of the forest. I would, however, again

emphasise what I endeavoured to emphasise at the start, namely that a forest is a living thing and that its continued output for the benefit of the nation depends on the care and treatment it receives. It must be fed and nourished if it is to continue healthy and give of its best. This nourishment means roads to get out the produce from the more difficult places, planting and tending of crops and the provision of a staff competent to carry out this work. Much of the revenue of the past has come from forest land that has now passed under cultivation. Most of the revenue of the future must come from our limited and less accessible reserved forests. To work these areas an increased expenditure on roads is necessary. To protect and manage them an increased expenditure on staff and labour is necessary. Unless this is realised and the necessary funds are forthcoming the forests of Burma will continue to produce for a limited number of years and then the forest revenue will collapse, as it collapsed in the case of Karenni.

Administration.—As already stated the Forest Department in Burma was inaugurated as a scientific department in 1856. There have been many developments since then, but I shall go straight to the present position

The Minister for Agriculture and Forests is the Chief Forest Authority for all forests outside the Federated Shan States.

The regular gazetted staff with special forest training is in two main cadres, the Indian Forest Service consisting of 113 posts for service in Burma and the Burma Forest Service consisting of 106 posts.

The Indian Forest Service is recruited with the object of providing highly trained officers for the controlling staff of the department. The Burma (Provincial) Forest Service is recruited to fill posts that are intermediate in responsibility between the subordinate and the controlling staff.

The Chief Conservator of Forests is the administrative head of the department for Forest Management, Utilisation, Research and Education, and the advisory head for territorial administration.

There are seven territorial Forest Circles each in charge of a Conservator. A Conservator of a territorial circle is in administrative control of that Circle. He is responsible for seeing that the policy laid down by Government is carried out, that forest management is carried out in accordance with the provisions of working plans, or where working plans do not exist, in accordance with sound silvicultural considerations; he must control all expenditure; he is responsible for all discipline inside his Circle and generally that all machinery concerned with the management of forests works smoothly and that funds are applied to the best advantage.

For purposes of major executive control, the unit is the Forest Division. There are at present 39 territorial forest divisions and two depôt divisions administered by the seven territorial Conservators.

A territorial Divisional Forest Officer is in direct charge of the forests in the division and responsible for their management on the lines laid down. The number of gazetted assistants attached to each division varies according to the work. For purposes of executive control each division is divided into a number of ranges. There are at present 240 ranges each in charge of a Ranger or Deputy Ranger. Each range is sub-divided into a number of beats and Deputy Rangers and Foresters are attached in proportion to the work to be done. The Range officer is directly responsible for the execution of all work and the protection of the forests in his range. He is directly in touch with the people. The efficiency of forest management depends largely on the efficiency of the Range officer and the value to the country of a really good Range officer is hard to estimate.

The permanent subordinate forest establishment including 225 Rangers totals 2,645.

In addition to the territorial staff there is the specialist staff in two main branches: Forest Management and Forest Utilisation, each in charge of a Conservator.

The Conservator of Forests, Working Plans, is the expert adviser on Forest Management. He is responsible for the preparation and control of working plans. He is assisted in the

preparation of plans by a special staff who examine the forests and under his guidance draw up working plans to regulate the extraction, regeneration and other works concerned with their management. His control consists in examining the returns showing work carried out under working plans and drawing attention to deviations or matters that require remedy. He is responsible in addition for all research work concerned with Silviculture including Forest Zoology and Forest Botany. Under him are six officers in charge of working plans parties; the Silviculturist who is in an advisory position on the subject of regeneration and directly responsible for all research work and statistics for his section and the Forest Botanist. The post of Forest Zoologist has not yet been filled.

The Conservator of Forests Utilisation Circle, acts as business manager to the department and is responsible for all economic research. He directs the sales of departmentally extracted timber, studies the question of markets for all timbers and generally, and so far as is possible, keeps in touch with market prices. His research work has for the present mainly been concerned with the seasoning of timber and the endeavour to find uses and markets for species that have hitherto been considered of little or no market value. Under him are the Myitmaka Extraction Division which is responsible for the extraction of teak from the area worked by Government; the Rangoon Depôt Division and the Economic Research Division with specialists in charge of Seasoning and Wood-Working. Economic research is concerned mainly with finding new uses for timbers that have at present no market value and increasing the uses to which various timbers can be put. As officers become available its scope will be extended to cover forest products other than timber. For purposes of trying out the uses of timber there is at the Rangoon Depôt one of the most up-to-date carpenter's shops in the East.

The outlook for the future.—The outlook ahead is far from being so simple as a review of the past. Our accessible and easily worked forests have for the most part gone under cultivation or been squandered by wasteful use. The demand for the products of the forest has increased and is increasing. It can

only be met by opening out the less accessible areas by roads and by planting. Increased study and research are necessary to enable us to increase the yield and to make full use of the material available. Increased reservation is necessary both to increase the area of supply and to preserve what is left of the unclassed forest.

All this means increasing expenditure and a staff competent to make the best use of the funds provided. Forestry calls for the best men the country can give, men with a liking for an outdoor life, and not the class of men who take up the work for the pay and prospects or because they can get nothing better If these men are forthcoming there is every prospect that the forests will continue indefinitely to be one of the most valuable assets of the country.

H. W. A. WATSON, I.F.S.,
Chief Conservator of Forests,
Burma.

A RÉSUME OF FOREST PRODUCTS RESEARCH IN THE BRITISH EMPIRE DURING 1923–1926.

(Continued from pages 141 to 150, "*Indian Forester*" *for March 1927.)*

GREAT BRITAIN.

Brief History.—Since the Imperial Forestry Conference of 1923, the prelimi lary survey of the field of work, involving an exploration of activities and methods in this and other countries and the building up of a liaison with other centres of research, has been completed by the Department of Scientific and Industrial Research, through the Forest Products Research Board. As a result of the above survey the Government decided upon the establishment of a Forest Products Research Laboratory and in October 1925 appointed a permanent Director with previous experience of this class of research to organise and direct the work.

A site of about 35 acres was purchased at Princes Risborough Buckinghamshire, and a Laboratory is in course of erection thereon at a cost, exclusive of site, of approximately £60,000. The

site adjoins Princes Risborough Station and has been equipped with a private siding. Princes Risborough is 16 miles from Oxford, thus ensuring close touch with the Imperial Forestry Institute; communication with London (35 miles) and other industrial centres is good. It is expected that occupation of the new research station, section by section as they become ready, will be begun in February next and completed by August.

The staff now employed and the addition proposed for the financial year 1927-28 amounts to 123 persons.

An expenditure of £31,293 on staff, plant and equipment and running expenses has been sanctioned for the current financial year. Estimated expenditure for the financial year 1927 28 has been taken at £37,349.

Organisation.—The Laboratory has been organised under nine sections, which are:—

(*a*) Timber Mechanics.
(*b*) Seasoning.
(*c*) Wood Technology.
(*d*) Pathology.
(*e*) Utilisation
(*f*) Wood Preservation.
(*g*) Wood-Working.
(*h*) Chemistry and Minor Forest Products.
(*i*) Permanent Records and Library.

Of these sections, Timber Mechanics, Seasoning, Utilisation and Permanent Records have been in operation for the past year in temporary quarters, kindly placed at the disposal of the Department by the Air Ministry, at the Royal Aircraft Establishment, South Farnborough, Hampshire. Wood Technology is being carried on at Oxford in co-operation with the Imperial Forestry Institute, with a joint staff of members of the Laboratory and members of the Institute, and includes work both on the anatomical (identification and structure) and physical (relations of wood to water and heat) sides. Similar co-operative arrangements have been made with the Imperial Forestry Institute in respect of Pathology (mycology and entomology) and with the Imperial College of Science and Technology, London, in respect of Mycology. Sections of Wood Preservation and Wood-Working are being organised and will come into operation as soon as the

buildings at Princes Risborough are ready. Meanwhile as regards Wood Preservation, promising work on the chemical side is being carried out by arrangement with the Imperial College of Science and Technology, London. In the chemistry of wood cellulose, work is in progress at St. Andrews University by arrangement with Principal Sir James Irvine, Chairman of the Forest Products Research Board; it is now proposed to add a Physical Chemist to the staff working on Timber Physics.

Work in Progress.—A list of the Projects now being undertaken is attached as Appendix 2.

Colonial Timbers.—A joint arrangement has been agreed to between the Forest Products Research Laboratory and the Imperial Forestry Institute, Oxford, for the examination and testing of the timbers of such colonies, who have no laboratories of their own, but who wish such work carried out. In this connection a joint circular has been prepared for the information of interested parties, entitled "The Examination and Testing of Colonial Timbers," a copy of which can be obtained from either the Forest Products Research Laboratory, Farnborough, or from the Imperial Forestry Institute, Oxford.

DOMINION OF NEW ZEALAND.

Brief History.—Though no central Forest Products Research Laboratory exists in New Zealand, a very considerable amount of research work has been carried out by the Forest Service in co-operation with the University Colleges of Auckland, Wellington and Canterbury. The Director of Forestry has for several years urged the establishment of a Central Institute to deal with Forest Economic problems and it appears likely that his recommendations will be acted upon in the near future. In the meantime a Branch of Forest Products in charge of an Engineer in Forest Products was formed in 1921, and this officer directs and controls the Forest Products Research programme carried out by the Engineering and Scientific Sections of the abovementioned Universities. The following notes record some activities of the Forest Service during the last three years in Forest Products Research.

Timber Mechanics.—One of the most important objects to be achieved by the Forest Authorities of the Dominion was to stimulate the use of hardwoods for constructional purposes. With this object in view comprehensive strength tests on the principal hardwoods were commenced in 1921-22, to demonstrate their suitability for wheel-spokes, poles, cross-arms, handles, cooperage, packing cases, etc. Since then much work has been completed; by 1926 so much data on strength values has been collected that the Forest Service are about to issue a manual on the mechanical and physical properties, together with recommendations for working-stresses and structural grading rules for the more important timbers of the Dominion. Recently a box-testing machine, similar in type to those in use at the United States Laboratories at Madison has been added to the equipment Even before its installation an investigation was commenced in connection with the construction of butter-boxes, the final results of which have proved that a box can be prepared which is not only stronger but which contains less wood than that in former use.

Seasoning Investigations.—A major investigation undertaken to ascertain the correct methods of air-seasoning New Zealand timbers has for several years engaged the attention of the research officers in co-operation with the Engineering Department of the Auckland University. Much valuable information has become available, with the result that the Forest Department has been able to broadcast to saw-millers and wood-users correct methods of dealing with the more important indigenous timbers and it is satisfactory to note that the methods advocated are already being applied throughout the Dominion. The installation of a seasoning-kiln is said to await the creation of a Forest Products Laboratory.

Wood Preservation.—As far back as 1920, antiseptic tests were carried out in open tanks on post, poles and out-door construction timbers to ascertain effective methods of treatment to preserve indigenous and exotic timbers, the material used being largely obtained from plantations. Of practical results obtained

may be mentioned the treatment of New Zealand grown indigenous and exotic species, the success in treating which permits of many less durable and secondary species being used in place of more durable woods of the first grade. Later, in 1925-26, the experimental work in treating native and exotic timbers in open tanks was continued and fourteen species dealt with, while a standard specification for vertical-retort creosotes was prepared in co-operation with the Dominion Laboratories and local manufacturers. An investigation to find a remedy for sap-stain was also undertaken and an effective method of overcoming this serious trouble discovered.

Wood Technology.—This most important subject has been steadily pushed forward by the Dominion Authorities. Professor G. A. Garratt, when working at Yale University made a study of twenty-eight New Zealand timbers, and prepared a key for eighteen species of hardwoods, while Professor Kirk of the Victoria University College is engaged on the preparation of a key for the softwoods.

Forest Entomology.—The work in Entomology has engaged the attention of Mr D. Millar, M.Sc., Entomologist to the Department of Agriculture, who has issued on behalf of the Forest Service a treatise on forest and timber insects in the Dominion, while he is continuing his survey on insects introduced by imported wood. To obtain knowledge of the life history and to determine definite methods of controlling insect pests in timber is of vital importance to the Empire Timber Trade, so that the work accomplished in New Zealand is of primary importance.

Minor Forest Products.—The Research Branch of the Dominion Forest Service has actively prosecuted a number of investigations under this head, amongst others may be mentioned those connected with the tapping of Kauri pine for resin, the distillation of Kauri waste and the preparation of pulp for paper from New Zealand timbers. In the latter connection Kauri-fibre has been found to produce a strong, good grade paper, which it is hoped may be the basis of a new industry in the Dominions, in that a new raw material has been discovered for this purpose.

The work accomplished in this Dominion in Forest Products Research must inspire admiration in anybody acquainted with this class of research, especially when it is remembered that no Central Institute dealing with such problems as yet exist. The credit is, therefore, the greater to the Forest Service and Research Officers concerned.

UNION OF SOUTH AFRICA.

Brief History.—The Forest Research Branch of the Union Government is under the direct control of the Chief Conservator of Forests and is located at Pretoria; this organisation is divided into two branches, namely Silvicultural Research and Timber Investigations.

The scheme to create a Timber Investigation Section came under the consideration of Government in 1917-18, and in 1920 a highly trained expert in artificial seasoning of timbers was recruited from the United States of America to investigate on scientific lines the seasoning of African timbers. In co-operation with the Railway Department an existing kiln was adapted for experimental work and a definite start made. The Timber Investigation Branch has gradually expanded, notably in 1922 23, when two different types of experimental seasoning-kilns were installed. Another line of research was also started with the erection of a temporary antiseptic plant, to which in the following year was added a complete experimental pressure plant with a 24 ft. cylinder To complete the necessary Laboratory equipment a 30,000 lb universal testing machine of standard American type was purchased with which to carry out strength tests on timbers. At the same time the staff was considerably increased, so that by the end of 1923 a nucleus Forest Products Research Station had been established, dealing with both air—and artificial—seasoning of timber, wood preservation, and timber mechanics, while the station also maintains a type wood collection and museum. With proper equipment and staff, very satisfactory progress has been maintained from 1923 to date, a brief review of which is given according to subjects.

Seasoning Investigations.—The investigations to ascertain the best methods of kiln-seasoning timber originally started in 1920, have been continued up to date, and by 1924 no less than 69 species had passed through the kilns, resulting in a great deal of very valuable information being collected, and standard moisture and heat gradients established. Notably, experiments have been conducted in the conversion, seasoning and utilisation of yellow-wood, stink-wood, white iron-wood, white pine, chemmen, Terblans and Saligna gum. The activities of this section have also been directed in giving advice to enquirers, preparing plans for new kiln-installations, and suggesting improvements and modifications to existing plants. Very tangible results have been obtained; plans for kiln-construction have been prepared for the Railways and a number of other concerns. It is also interesting to note that the Uganda Railway has made use of plans prepared by the Seasoning Section at Pretoria, and the Tanganyika Forest and Lumber Co., Ltd., has not only erected a full battery of such kilns but engaged as operator a man trained at the Pretoria Forest Research Station The kiln-seasoning of timber by private firms is noticeably on the increase in South Africa, due largely to the activities of this section of the Timber Investigation Branch of the Research Institute

Wood Preservation On the installation of the experimental wood preservation plant being completed, absorption tests were commenced on fencing posts, mine timbers, telephone poles and sleepers. In this connection different species of timbers have been tested by the full cell, rüping or open-cell and card processes and the timbers laid down for durability tests. The results of some of the experiments already indicate the efficiency of the various antiseptics against powder-post beetles, pin hole borers, white-ants, and fungus attack. The service tests of sleepers are being carried out in co-operation with the Railway Department and those on pit-wood and pit-props in the Ferreria Deep Mine. The Section of Wood Preservation has issued a report on its work, entitled "Experimental Timber Preservation in South Africa," Bulletin No. 11 of the Forest Department.

Timber Mechanics.—Routine tests, and also tests on aeroplane woods for the Defence Department have been carried out on the Rhiele machine installed at the Wood Preservation Station.

Wood Museum and Type Specimen Collections.—A large number of type specimens of both indigenous and exotic species and articles manufactured therefrom have been prepared for the Departmental Museum and for the travelling Forest exhibit staged at agricultural shows.

ENGLAND:
3rd November, 1926.

RALPH S. PEARSON,
Director, Forest Products Research, Hants,
(Department of Scientific and Industrial Research).

APPENDIX I.

Example of one year's investigations in Canada.

Process yielding good sulphite pulp from Jack Pine (*P. Banksiana*).

Freeness as a Control Test in Groundwood Production.

Pulp Testing.

Chemical Research on Cellulose.

Refining of Waste Paper Stock.

Testing New Materials for Paper.

Preparation of Reference Collection of Microscopic slides of Canadian Woods

Kiln Drying.

Physical Properties of Pulpwood with reference to Deterioration in Storage.

Mechanical and Physical Properties of Canadian Woods.

Glued Joints.

Nail Retention by woods.

Effect of "Red Stain" and "Red Rot" on the strength of Jack Pine railway sleepers.

Wood Preservatives.

Forestry Exhibit at B. E. Exhibition.

Over 500 answers to Technical enquiries.

APPENDIX 2.

Project 1.—Test on small Clear Specimens of Home grown and Colonial Timbers.

Project 2.—Test of Pit-props.
Part 1.—Seasoning Properties.
Part 2.—Mechanical Properties.

Project 3.—Tests on Structural Timber.

Project 4.—Decay in Sitka Spruce Timber.

Project 5.—Investigation into the Kiln Seasoning Properties of the commoner Commercial Timbers.

Project 6.—Investigation into the losses caused by *insects* to Timber in store, with special reference to the *Lyctus* problem at High Wycombe.

Project 7.—Scheme of work to be carried out on the Impregnation of wood with Silico-Fluorides.

Project 8.—Proposed Scheme of Experimental Investigation of the factors influencing and controlling the movement of moisture and heat in converted timber, with special reference to its bearing on the problem of timber seasoning.
Part 1.—Moisture Movement.
Part 2.—Moisture Movement.
Part 3.—Heat Movement.
Appendix.—The Determination of the Specific Heat of Wood.

Project 9.—Wood Structure. Microscopic Investigation.

Project 10.—Investigation into the marketing, strength values, seasoning and machining qualities and uses of *Quercus pedunculata*, Ehrb., and *Quercus sessiliflora*, Salisb. (*Q. robur*, Linn).

Project 11.—Investigation of the moisture content of wood in relation to temperature and humidity conditions, with the particular object of determining the most suitable moisture content for

timber which is to be used in the manufacture of various kinds of furniture and decorative work.

Project 12.—Brashness in Timber.

Project 13.—The investigation of timber losses caused by Fungal Decay, including the relationship of Fungal Infection.

REVIEWS.

REPORT ON THE FORESTS OF BRITISH HONDURAS.

BY C. HUMMEL. REPRINTED 1925.

ANNUAL REPORT OF THE FOREST TRUST BRITISH HONDURAS, 1926.

Mr. J. N. Oliphant, Conservator of Forests, has sent us a copy of these reports which we have read with great interest more especially so when it is realised that Mr. Hummel's proposals for a far reaching forest policy have been adopted and that in the words of the Conservator "Some of the potentialities indicated notably the pine and secondary wood industries and the silvicultural development of Mahogany and Sapodilla forests have since become realities."

The work is divided into seven parts. In Part I the author points out that the mahogany industry is the main industry of the Colony and has been so for 200 years, yet, although the country possesses the usual set of Government departments with an estimated expenditure of nearly one million dollars, nearly all of which income is derived directly or indirectly from the forests—it has no Forest department !!

These valuable forests have never been under any professional or other systematic management, with the result, that a large portion of the original capital stock has been removed and is lost for good. It has not been sufficiently replaced by reproduction. It is true that, owing to the natural difficulties, this process of using up capital stock has been such a slow one that many superficial observers have hardly noticed it within their own life-time, but in the aggregate the result is that the forest and therewith the whole country, has to a very serious extent been made poorer.

In the absence of such a policy this country has remained in an undeveloped state.

Once before in her history, the forests of British Honduras were investigated. This was done 35 years ago, in 1886, by Mr.

E. D. M. Hooper, of the Indian Forest Department. His inspection was a short one of only about two months. In his report which contains a number of interesting observations, he recommended the establishment of a Forest department, which was not done.

Mahogany and Cedar.—The main product of the country is at present mahogany, and the main industry is the export of mahogany wood. The latter has a well established market, and the *intrinsic value* of this wood is such, owing to its excellent technical qualities as compared with other woods, that it will always command a good market in the future, as it has had during the last two centuries.

One of the first questions is, therefore, whether the mahogany forests are in such a condition that a sustained future supply of this commodity at a reasonable price from this country can be considered a certainty, and, if not, what steps have to be taken to put the present main industry on a safe basis for all time. What has been said here about mahogany applies in a lesser degree also to cedar, which latter is exported in much smaller quantities.

Chicle.—Another well-established industry is the trade in chicle, or chewing gum, the product of the sapodilla tree, which grows together with the mahogany. The future of this industry is, however, not nearly so certain as that of mahogany, because for an article of this kind it is more likely that substitutes may be found or manufactured or that the consumption of chewing gum may decrease or be replaced entirely by some other equally bad habit.

The Pine Forests.—The pine forests of British Honduras deserve special attention, since they cover one-third of the of the whole country. Besides, the soil on which they grow is, generally speaking, too poor for growing anything else but pines. Only certain selected and relatively small parts can be used as pasture land during the whole year, whilst the poorer grass on the greater part of the pine area can be used for cattle grazing only for a short period. It appeared desirable to find

here a suitable combination of wood growing and cattle grazing and that has been found now. The wood of the British Honduras pine is quite good and very durable and compares favourably with most of the different kinds of pines of other countries. This pine has very much the appearance of *chir*.

Part II deals with the present state of the forest industry and the volume of trade. The most interesting item for Indian foresters is that the present yield of 25,000 tons of mahogany obtained from something like 2 million acres of forest could be produced under management on some 15,000 to 30,000 acres of well stocked forest, thereby enormously reducing costs of production, increasing the total yield and necessitating the gradual development of the whole country out of current forest revenue.

There are at present no working plans, not even of the roughest kind, in use, or anything resembling them. There is in most cases great uncertainty with regard to the available stock of mature trees even on relatively small areas. No efforts of any kind have ever been made to ascertain the probable future yield and to see if the future of the existing export trade is on a secure basis.

The outstanding feature of the present working methods is the very high cost of exploiting the forests —This is due partly to the absence of roads and railways, and partly also to a fact which could be remedied very quickly, *i.e.*, the lack of *systematic* working.

Great improvements and savings could be made in this direction by exploiting the forests more systematically after more thorough investigation.

Mr. Hummel sums up the situation as follows :—

" *Our aim must be* —

(1) To improve the present conditions so that the cost of exploiting the forests will gradually become smaller.

(2) Thus to make competition with other countries in the world's market easier.

(3) To concentrate gradually the growth of mahogany on favourably situated areas, to increase its stock and also the output and to get a much greater share of the world's trade in mahogany, which grows here under favourable natural conditions and in very good quality.

(4) To find a market for some of the useful secondary woods.

(5) To get the greater part of the country gradually opened by privately constructed logging railways under concessions for long periods and by more systematic exploitation according to simple working plans instead of the present hand to mouth system, which leaves no permanent mark of progress in the country.

(6) The final result would be a considerable increase of the whole trade of the Colony on a safe, permanent and more profitable basis, and at the same time the opening up of the greater part of the country by logging railways which would cost the Government nothing. *This can be done.*"

Part III describes in detail the different types of forest found of which the mahogany, pine, and sapodilla forests are of most interest to us.

Mahogany forests.—The forest which is called here a mahogany forest is really a mixed tropical forest composed of more than 200, possibly 500 to 800, different species of trees. Only a relatively small percentage of these trees are mahogany trees. There are no pure mahogany forests. Occasionally, but not often, one finds a number of mahogany trees growing close together and forming small groups, but usually single mahogany trees are scattered about the forest in single mixture with the numerous other kinds of trees. A stock of one good mahogany tree per acre may be considered to be a good average stock under the present circumstances.

There is a certain amount of natural reproduction of mahogany but not enough to replace the number of felled trees. The available stock is, therefore decreasing. From a financial point of view only a part of the annual outturn of wood can, therefore, be considered to be current production; the other part is taken from the capital stock of the country. This country has thus been living partly at the expense of future generations.

Mr. Hummel proves the decreasing proportion of the younger age classes by a series of enumerations and advocates extensive improvement fellings bearing on the existing stock of trees which would enormously increase their growth and extend their regeneration and this is the line on which silvicultural improvements are being carried out. From the Annual Report of the Forest Trust for 1926 it appears that from the start of the forest department 51,492 trees and seedlings, mostly mahogany have been improved and the Conservator remarks that many seedlings are already well into the sapling stage. The remarkable feature of mahogany is its rapid rate of growth, although statistics are meagre, yet the author by measuring heights and girths of trees of known ages and comparing the results with figures for *Swietenia macrophylla* plantation in Ceylon, arrives at the conclusion that maturity (six feet girth) is reached under proper treatment at an age of 30 to 50 years when a yield of 5,000 cubic feet may be expected. This compares with a yield of sal I quality of 5,170 c.ft. stem timber at a rotation of 80 years but the sal will only average 16·8 inches in diameter or a girth of 4 ft. 4 ins. It is pointed out, however, that this growth is only obtained under management and that the growth of the wild trees often suppressed and festooned with climbers is very much slower.

Sapodilla forests.—As regards the sapodilla which should really be grown on plantation lines drastic improvement fellings to favour the so-called female sapodilla, probably *Achras sapota*, are recommended with a view of developing large spreading crowns.

The tapping of the sapodilla trees is done in an entirely different way from that of the Para rubber trees. It is not

renewed every day as in the latter case. After the first tapping which is a severe one, the sapodilla tree is left alone again at the very least for a whole year, but more usually for a number of years, and sometimes for ever—when it is found that the tree was tapped to death, which occurs often enough.

The cuts are not made on the "herring bone" system, but in a zigzag line from near the ground right up to the first branch. The chicleros are very clever in climbing any tree without much difficulty with the help of strong iron spurs on the legs, and a rope round the stem, which is moved upwards by degrees with a quick movement of the hand. This rope is tied round the waist. It rarely happens that a chiclero breaks his neck, and in such cases it is usually found that a worn-out rope was used.

The zigzag shape of the cuts originated not from any consideration as to the most economic way of bleeding the trees but is solely due to the fact that it can easily be made with the ordinary bush knife, the "machette," without which no native goes into the forest. The machette is much longer than the Malay "parang" and straight.

Pine Forests.—About one-third of the whole area of the country is covered by pine forests. Their nature is entirely different from that of the already discussed forests of mahogany and sapodilla. The difference lies in the fact that the British Honduras pine *(Pinus cubensis)* forms *pure forests* of this one species.

The greater part of the British Honduras pine forests are on low lying and flat land of poor sandy soil; there are, however, also some pine forests found on hills. The general appearance of the low lying pine ridge is very deceiving in wet weather; the first impression is that travelling (and also the extraction of timber) over this fairly open, flat and sandy land should be very easy in any direction and at any time, many creeks, rivers and swamps, however, cannot be crossed by man and horse during the wet season.

The following notes from Mr. Hummel's diary illustrate this:—

"On more than one occasion (on Sunday, 31st October 1920) my guide and I found it impossible to cross insignificant creeks

because the banks were too swampy, so that the horses sank too deep before they got into the creeks. At the first creek, met after one hour's ride, we had to make a deviation of about one mile towards west; then we came to a long but narrow strip of swamp, we tried to get through it, but had to turn back, as it was too deep; we went then a long way around it. Similar difficulties occurred repeatedly; they are supposed not to exist during the dry season, or only to a small extent. On nearly the whole way the ground was so soft from the rain that the horses could rarely go fast. This is also not the case during the dry season."

The stock of the pine forests of this country, with only a few and very small exceptions, is in a sub-normal and unsatisfactory state; they are subject at present to a process of slow, but sure, destruction by fire. The mature trees succumb gradually and the young seedlings get usually killed by fire in their first year of life so that no young forest can grow up.

On several places the pine forest has actually been destroyed so entirely that not a single living tree is left, and on large areas the destruction is so far advanced that the former forest can no longer be classed as a "forest;" it is, now poor grass savannah with some pine trees on it and with numerous half-burnt trees lying on the ground; thus showing that there was a forest before.

The measures that have to be taken for bringing these pine forests into good order are relatively simple, but require great energy and have to be applied systematically by a special staff. They are not expensive, and their cost can probably be defrayed out of the current revenue from the very same pine forests, as soon as a proper start is made.

One peculiarity of the British Honduras pine, which I have observed in most places will help to make the reafforestation easy and cheap; *i.e.*, the plentiful natural reproduction, which, under present conditions, is, of course, again destroyed by fire every year; tiny young seedlings, usually hidden between and below the grass and not seen and recognised by most people, are found in great numbers. This fact is of great value, as it saves a large amount of expenditure for artificial reafforestation, which would

be necessary otherwise. The latter may be required in exceptional cases only.

The ownership of the forests and land policy is dealt with in Part IV where it is pointed out that it is folly to sell land for \$3·50 per acre when the stumpage of a single mahogany or cedar *(Cedrela odorata)* is \$6 and the value per acre of good mahogany soil before planting is in the neighbourhood of \$80 per acre. This figure is based on a yield of 30,000 ft. B.M. at a rotation of 40 years corresponding to a value of \$1,500, and it is pointed out that these values can be produced on a big scale under the direct management of a Government Forest department.

The constitution of a forest department manned by trained officers is constantly urged throughout this excellent report and in particular in Part VI.

The Colonial Office are to be congratulated on having accepted the report and introduced scientific forest management without delay and we have no doubt that in time great benefits to the Colony will ensue. The whole history of the mahogany trade of British Honduras is an excellent example of the fate of a forest industry divorced from professional forest management. What has here happened is what happened in India up to 1860 and what is still happening in North America. In this review it has only been possible to mention the major items dealt with by Mr. Hummel. We have read the whole book with much pleasure and congratulate the author on an excellent and constructive report and still more on its adoption.—(ED.)

ON THE TWISTING OF TREE TRUNKS.

PAUL VON OYE. BULL. SOC. BOT. DE FRANCE, 1926, PP. 270—288.

The author basing his remarks on general observations in the Belgian Congo and a more detailed study on avenue and forest trees around Brussels, and dealing with broad-leaved trees only, has come to the conclusion that spiral growth is to be traced to the variations in the root system. He finds that as long as a tree has a predominant tap root, twist does not appear, but as soon as spreading roots replace the tap, twist will be developed if the laterals join the base of the trunk in a tangential plane unless their effects cancel out. The illustrations he gives are confusing but the idea is a simple one and worth further examination, and the reviewer would be very glad to hear of any records for Indian trees. Von Oye finds that the change in percentage of twisted stems alters with age in the same way as one would expect for the known changes in the root system (*e.g.*, oak and beech), and he considers that the tendency to develop twist is a specific character varying in degree with the

species. He also finds that conditions on a slope are much less favourable to the development of twist (laterals tend to be produced mainly along the contours and to cancel out) than on the flat, whence the wonderfully practical deduction that to keep down the percentage of twist, trees should be raised on slopes and transplanted later!

The prevalence in both hemispheres, of twist to the right has exercised his mind and he finally ascribes it to the differences in the effect of the earth's rotation on the north and south sides of a tree, a minute but possibly cumulative effect. We have tried hard to grasp this but fail to see how any effect of the earth's rotation can differ in kind from heliotropic stimulus in that both must produce opposite results in the North and South Hemispheres.

It is at once apparent that Von Oye's theories are inapplicable to conifers which commonly begin *with a left twist and* may finish up right handed, and this fact robs them of general application

H. G. C.

GUM ARABIC WITH SPECIAL REFERENCE TO ITS PRODUCTION IN THE SUDAN.

By H. S. Blunt, M A (Oxford University Press, Bombay. Price 10s. 6d.)

This publication gives a comprehensive account of the production of Gum Arabic from *Acacia Verek* in the Sudan.

In the opening chapter the author has given a definition of Gum Arabic and then proceeds to trace the history of the production of this gum from the early ages to the present day.

A description of the province from which the main part of the gum is produced and of the conditions prevailing in that province enable the reader to understand how these influence its production and to understand the steps that are being taken to further its production.

The exploitation is clearly described and there is also an interesting account of the manner in which the gum is marketed.

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A chapter is devoted to the chemical properties of the gum and to the various uses to which it is put.

The publication closes with a chapter describing the present policy of the Forest Department and the steps which the Department is taking to protect the existing *Acacia Verek* and to further its production and cultivation

The publication is very well got up and is profusely illustrated with good photographs and should prove of interest to the Sudan Government Officials and to all persons interested in the gum trade. It should also be of interest to forest officers in India who are in charge of extensive forests of *Acacia arabica.*

F. D. A.

EXTRACTS.

THE IMPERIAL FORESTRY INSTITUTE, UNIVERSITY OF OXFORD.

SECOND ANNUAL REPORT, 1925-26, AND PROSPECTUS.

(*Continued from pp. 170—181, "Indian Forester" for March 1927*)

13. Two courses were given: (1) the full course of three terms for probationers and those officers who were on leave for the full period of the academic year, and (2) a special short course for forest officers on leave for only one term. Twenty-two students have taken one or other of these courses. They represent the following Colonies or Provinces (arranged according to the proportion of students from each): Nigeria, the Federated Malay States, the Gold Coast, Sierra Leone, Kenya, Assam, the Punjab and Ceylon. Such a wide geographical range of interests made it necessary to give separate and almost individual attention to each group of students.

14. An important function of Dr. Burtt Davy's work lies in the co-operation with overseas forest departments of the Empire in the identification and naming of timber trees in the Dominions and Colonies, the facilities afforded by the Royal Botanic

Gardens, Kew, being an invaluable aid in this respect. Many of the tropical trees are known only by loosely-applied vernacular names, which are notoriously misleading, a single name being often applied to many different botanical species of very varying economic importance Commercia names are equally unreliable: thus 172 distinct species of trees, representing many genera and several families, have been listed which pass under the name of 'Mahogany,' although there are only two true mahoganies of the genus *Swietenia*, none of the others furnishing timber which is exactly similar. The only precise criterion is the scientific name accompanied by an accurate botanical description.

15. The number of identifications made at the Institute during the year on behalf of the Colonial Forest Departments and correspondents at Home and overseas comprises 439 specimens, made up as follows: Gold Coast, 150, Kenya, 84; Sierra Leone, 78; Nigeria, 72; South Africa, 11; Trinidad, 6; correspondents in England, 38. In addition to this, a large number of specimens in the herbarium have been named. This work of identification has brought to light approximately twenty species which appear to be new and undescribed, *viz.*: from the Gold Coast 9, from Kenya 8, and from Sierra Leone 3. In most of these cases additional material will be required before complete descriptions can be drawn up for publication. It is hoped that when this is done they may be issued with good illustrations to accompany the descriptions.

16. A study has been made of the Trinidad timber trees passing under the name of *mora*. Three forms are recognised in the Island, the white, the red and the grey *mora*. Specimens received seem to show that these represent three separate species, or possibly three varieties of one species. Further investigation in the field will be necessary before determining whether they are more than mere forms of a single species

17. The necessity for building up a good teaching and reference herbarium is fully recognised, and satisfactory progress has been made during the year in accumulating and naming specimens with this object. During the year sixty-five consignments of

herbarium specimens have been received, comprising in all 6,661 sheets, of which 1 331 were purchased, the remainder being received as donations or exchanges or sent for identification.

18. *Structure and Properties of Wood.* For the greater part of the year this section was under the charge of Dr. Forsaith, from the New York State College of Forestry, Syracuse, who was appointed for a period of fifteen months while on sabbatical leave. He relinquished his duties and returned to America in September, when Mr. Chalk assumed charge of the section. Dr. Forsaith's work in organizing this section has been of the greatest value. In collaboration with Mr. Chalk he has laid the foundations of a laboratory which, in point of organisation and equipment, promises to be one of the leading centres in the Empire for the structural examination and identification of timbers.

19. Students in the structure and properties of wood may be divided into two categories : (1) those requiring a general course which will enable them to recognise the chief types and the more important species of timbers in the region with which they are concerned, and (2 those who desire to specialise in problems relating to the structure and identification of woods. There were ten students of the former category and two of the latter. In addition there were four research students receiving grants from the Department of Scientific and Industrial Research.

20. During the year 125 specimens of wood were received and identified As already noted, much confusion exists as to the correct identity of a large number of timbers. In many instances an accurate determination of species cannot be made from the anatomical characters of the wood alone. The chief difficulty at present is that many wood specimens have been collected from trees whose botanical identity has not been determined, or what is worse ' has been incorrectly determined owing to the loose application of vernacular names or for other reasons. With the view of placing the specific identity of each wood specimen beyond doubt, a representative type collection of woods whose identity has been established with the aid of

botanical specimens from the same tree is being built up. In this work assistance is being rendered by forest officers in various regions. Meanwhile the existing wood collection is being carefully examined, and already some 5,000 microscope slides, representing 550 species, have been prepared, two sets for the type collection and spare sets for the use of students and for distribution. Photomicrographs of a large number of these have also been made.

21. Mr Chalk has been engaged on an investigation into the growth of secondary xylem of ash and Douglas fir, and has also carried out preliminary work on the anatomical variations in important conifers grown in Great Britain.

22. Some important work is being carried out at the Institute by the Timber Physics sub-section of the Forest Products Research Laboratory (Department of Scientific and Industrial Research). This sub-section, which is located at the Institute, works in close co-operation with the section of Wood Structure. Mr. Martley worked on the problem of moisture movement in wood, Mr. Van Rest carried out research on the conduction of heat in wood, and Mr. Rendle was engaged on a study of the anatomical features of Trinidad woods and on identification work.

23. *Mycology.*—Mr. Day was in charge of this section. No students of the Institute specialised in this branch of work during the year. Mr. Day continued his research, begun previously, on *Armillaria mellea* as a parasite of conifers, and one phase of this work, dealing chiefly with the method of penetration, was brought to a conclusion. The *Keithia* disease of *Thuja plicata* in Bagley Wood has been under observation, and measures for its eradication are being considered. Several other investigations of diseases and wood rots have been carried out, one of the most interesting being a case of disease of lime trees in Cornwall. It was possible, subject to confirmation by experimental work, to attribute this disease to bacteria infecting the living tissue of the cortex; apparently the disease has not yet been described.

24. As a result of negotiations with the Department of Scientific and Industrial Research, it was decided to attach an assistant mycologist to the Institute to work on behalf of the Forest Products Research Laboratory on the decay of timber caused by fungi, Mr. F. J. Nutman, who was appointed to this post, took up his duties towards the end of the year.

25 Steady progress is being made in the extension of the collection of fungi important as forest pathogens or as causing the decay of wood. The accessions include an interesting set of herbarium specimens of fungi parasitic on leaves of trees in the United States of America, presented by Dr Boyce, of the Bureau of Plant Industry, U. S. A.

26. *Entomology.*—This section was under the charge of Dr. Munro, Entomologist to the Forestry Commission, with Mr. Chrystal as Assistant. Towards the end of the year Dr Munro resigned his appointment under the Forestry Commission, and hence severed his connection with the Institute, and Mr. Chrystal succeeded him in the charge of the Section of Entomology.

27. Two students of the Institute specialised in this branch of work, attending lectures on advanced entomology and field research methods given by Dr. Munro, and making a special study, partly at Oxford and partly at the British Museum, of certain groups of insects important to forestry in the regions in which they were specially interested, namely, Burma and the Malay States: the chief insects studied in the former case were those injurious to teak, and in the latter the wood-boring families of Coleoptera with special reference to the Indo-Malayan fauna.

28. Research work carried out during the year on behalf of the Forestry Commission included a study of the bionomics of the chafer beetles injurious in nurseries, the control of the pine weevil (*Hylobius abietis*) in recently felled and standing woods in the New Forest, studies of *Chermes cooleyi* in relation to its attacks on different types of Douglas fir, and a preliminary investigation of the bionomics of the pine-shoot moths in East Anglia.

29. Work carried out at the Institute on behalf of the Forest Products Research Laboratory consisted of an investigation on the methods of controlling the powder-post beetles of the genus *Lyctus* by means of moist heat, with special reference to the control of these beetles in timber yards and warehouses. This investigation, which was conducted by Dr. Fisher under the supervision of Dr. Munro, is approaching completion, and the results are about to be applied on a commercial scale.

30. *Forest Economics.* Eleven students of the Institute attended lectures on Forest Economics and Policy by Mr. Hiley: these represented India (3), Malaya (3), the Gold Coast (2), Nigeria (2) and Cyprus. Dr. A. Saari, Professor of Forest Policy, University of Helsingfors, worked during the Michaelmas Term, 1925, and prepared a paper on Prices of British Timber Imports.

31. *Soils.*—It has been found impossible, for lack of laboratory accommodation, to start work on soil problems in relation to Forestry. Seven students of the Institute received instruction in this subject in the Department of Rural Economy: these represented Nigeria (2), the Gold Coast (2), Cyprus, India and Burma. It is of great importance that the study of soils in relation to Forestry should be taken up at the Institute as soon as circumstances permit, since the solution of many silvicultural problems depends on the study of soil factors. It is hoped, therefore, that more extensive laboratory accommodation will be available before long.

32. *Surveying and Engineering.*—Eight students underwent a special course of Surveying and Engineering under Mr. MacKenzie, the Colonies represented being Nigeria (2), the Gold Coast (3), Sierra Leone, and Malaya (2). Two of the probationers now under training will be given special instruction with the view of assisting in the forest survey of Nigeria. The Institute possesses good facilities for a complete training in Surveying. The Forest Engineering branch will be greatly strengthened during the coming year by the appointment of an experienced forest engineer, and training will be of a more comprehensive and practical character than has been possible

hitherto. During tours on the Continent the opportunity is taken to visit forest engineering works under construction and in operation

LIBRARY AND REFERENCE SYSTEM.

33. During the year some 200 books were added to the Library, which now contains about 1,400 works together with complete sets of 63 different periodicals and numerous other publications dealing with various branches of forestry. In addition to this Departmental Library of works relating to forestry, the Bodleian and Radcliffe (Science) Libraries are at the disposal of the staff and students. All information contained in periodicals, bulletins, reports and sundry publications is referenced under a system which places at the disposal of the staff and students all published information available on any item connected with forestry.

PROSPECTUS 1926 27.

Scope of Work.—The Institute is intended to provide courses of advanced study, its work comprises (1) post graduate training of probationers for the forest services and other qualified persons, (2) training of research officers in special subjects, and (3) provisions of courses for selected officers already serving.

The Institute does not undertake to provide a general training in Forestry such as is given at Universities or other centres where this subject is taught.

Admission of Students. Only persons falling within one or other of the following categories are eligible for admission to the Institute :—

(*a*) Those possessing a Degree in Forestry or a Diploma or equivalent certificate of having satisfactorily completed an approved course of training in Forestry who have been selected as probationers for the higher branch of some forest service ;

(b) Graduates with honours in Science who desire to become specialists in some branch of work connected with Forestry;

(c) Forest officers deputed by their Governments to attend courses with the view of bringing their professional knowledge up to date;

(d) Students of approved qualifications not included in the first three categories who are admitted on the recommendation of Overseas Governments;

(e) Students with a University training in Forestry who may wish to attend the Institute on their own account and at their own expense.

NOTE.—No officer in any Public Service in the British Empire will be admitted to the Institute unless he is officially deputed by the Government under which he is serving; (2) the Board of Governors of the Institute reserve the right to refuse the admission of applicants other than nominees of controlling departments (the Colonial Office and Forestry Commission).

Names of applicants for admission should be sent together with details of previous training and subjects which it is proposed to study, to the Director, Imperial Forestry Institute, Oxford, at least three months before the date on which it is proposed to join: the Director cannot undertake to consider applications received at shorter notice.

Terms and Vacations.—The academic year begins early in October, and is divided into the following Terms and Vacations:—

Michaelmas Term (8 weeks, early October to early December).

Christmas Vacation (early December to middle of January).

Hilary Term 8 weeks, middle of January to middle of March).

Easter Vacation (middle of March to end of April).

Trinity Term (8 weeks, end of April to end of June).

Long Vacation (early July to early October).

Courses of Study.—The courses of study are normally of three kinds:—

(1) For post-graduate probationers who have not yet taken up their appointments: the course ordinarily extends over one academic year, beginning October, and including practical work in part of the Easter and Long Vacations.

(2) For forest officers on leave, or others who propose to attend the Institute with the view of spending some time (normally one year) in specialising in some particular branch of work: the course of study will be adapted to individual needs, and will ordinarily begin in October

(3) For forest officers on leave who propose to spend part of the year only on 'refresher' courses *These should attend during the spring and summer months, and not between October and January.* The distribution of work in the more usual subjects studied in 'refresher' courses is as follows:—

Silvicultural Systems: Trinity Term, with continental tours in Easter and Long Vacations (middle of March to middle of September).

Methods of artificial regeneration: Hilary and part of Trinity Terms and Easter Vacation (middle of January to end of May)

Forest Management, including Working Plans, Mensuration and statistical work for Colonial conditions: Trinity Term and Long Vacation (end of April to end of August).

Tropical Silviculture: Trinity Term (end of April to end of June).

Continental Tours: Easter and Long Vacations.

Subjects of a more special kind, such as Entomology, Mycology, Wood Structure, Soil Properties, Surveying, etc., can be studied at times to be arranged to suit

individual requirements, provided notice of not less than three months is given.

Fees.—An inclusive fee of £75 will be charged for instruction for one whole year at the Institute. If the course of studies extends over less than one year, the fees charged will be £25 per Term and £1 per week for tours in the Vacations. These fees will include all charges for instruction both at Oxford and on tour, as well as for the use of apparatus, materials, library, etc.; they will not include living and travelling expenses. Reduced fees may be charged in individual cases, at the discretion of the Director, to students who do not belong to, or who are not probationers for, any Public Service

No fees will be charged to students deputed by the British Forestry Commission or the Colonial Office.

Expenses.—Living expenses at Oxford during Term are roughly estimated at from £3 10*s*. to £4 10*s*. a week. Expenses on the Continent vary considerably with locality and other factors, but ordinarily living is, if anything, cheaper than in England.

Membership of the University.—Students of the Institute may, at their own discretion, become members of the University, if eligible; particulars regarding admission, expenses, etc., are given in a pamphlet entitled *General Information concerning Admission, Residence, etc.*, obtainable (post free 6½*d.*) at the Clarendon Press Depôt, High Street, Oxford.

TIMBER DEVELOPMENTS IN UGANDA.

The bulk of the timber supplies of Uganda, which annually exports several thousand pounds worth, is derived from the Minzira Forest, on the Tanganyika border. A new sawmill capable of turning out 1,500 tons of timber annually, is being erected at Katera, seven miles from the lake, and a pier has been erected at Sango Bay, and a light railway laid to Katera. This should lead to a marked increase in the export of timber. The principal species extracted from the Minzira Forest are *Podocarpus graci-*

lior Musenene), *Baikcæ eminii* (Nkoba) and *Mimusops cuneifolia* (Mukunyu). Operations on a smaller scale are carried out by manual labour in the Budongo Forest in Bunyoro and in the savannah forests in Busoga.—[*Timber News*.]

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THE THEORY OF FOREST TYPES

The classification of forests according to quality is indispensable both in scientific enquiry and in practical management. The neglect of quality classes in Indian working plans has led to great errors in the allotment of areas to periods and consequently in the calculation of the yield; and the rectification of this initial error has often presented considerable difficulties at subsequent revisions. In all plans based on area, where different qualities occur, it is essential that equi-productive areas as opposed to actual areas be used in the allotment of areas for felling, either annually or over a period of years. The first classification of areas according to quality preceded the preparation of yield tables by the Silvicultural Branch at the Forest Research Institute, Dehra Dun, and was mostly done by eye. This method is fairly satisfactory in the case of an individual who has an intimate acquaintance with the species and locality with which he is dealing, but completely breaks down in the absence of this individual experience. With the publication of yield tables for the more important species of Northern India the classification of areas according to quality by height measurements, following the height age curves of the different quality classes of the yield table, became simplified and founded on more scientific data. Now in forestry there are two kinds of forest classification by quality, first according to the quality of the stand actually growing on the area and secondly according to the quality of the locality or site. All the European and Indian yield tables deal

with stand quality classes. The Indian tables are usually confined to three quality classes in the case of sal the need of a fourth quality has been felt although it is difficult to find crops of this quality suitable for measurement). The basis of this classification is to take an average curve for the best sample plots, the same for the worst and to average the difference for the middle quality. All such qualities are really arbitrary, it is impossible to compare the quality classes of any one species with the corresponding quality of a different species growing on similar sites, and no examination of the soil will enable the forester to predict the quality of forest crop that particular site will be able to produce. Consequently the determination of the relative financial advantages of growing different species becomes almost impossible. This subject of the theory of forest types has for years received the attention of foresters in Finland and Cajander in Acta Forestalia Fennica No 29* summarises the results of his researches in an illuminating paper dealing with this most interesting subject. In this article we propose to deal with Cajander's researches for the benefit of our readers, but to those specially interested in botanical and œcological research we recommend the perusal of the original which is published in English by the Society of Forestry in Finland, Helsingfors.

The criticism of the classification of localities (= sites) according to quality elaborated by Baur, is that these qualities are mere graphical abstractions which have been fixed quite arbitrarily inasmuch as it is possible to distinguish 5, 6 or more quality classes as may be desired: that no guarantee can be given that the growth of any stand of normal development is in reality such as is represented by the normal curves drawn according to Baur's method and that the recognition of these quality classes, whether based on standing volumes or heights, is difficult by reason of the abnormality of the overwhelming majority of stands. Cajander points out that there is no guarantee that the volume curve and height curve will correspond with one another. Further the mean height of a stand over mean age is not easily calculated, especi-

*The Theory of Forest Types by A. K. Cajander.

ally in the case of unevenaged crops, and the height of a stand is to a very great extent dependent not only on the locality but also on the nature of the thinnings applied to the stand and more generally, on the method of treatment to which it is subjected. While it is possible to mitigate certain of these objections to Baur's method, and, by basing the curves of the yield table on the actual development of the same sample plots over a series of years to obtain a natural as opposed to a purely artificial curve, still certain objections to this method still remain and cannot be eliminated by any further adjustments. The most important of these objections as previously stated is that quality III, established for instance on the data for Scots pine stands, by no means corresponds to quality III class obtained from Norway spruce stands. Similarly in this country it is impossible to compare quality II of blue pine *(Pinus excelsa)* with quality II of deodar *(Cedrus Deodara)* as we cannot tell what quality of deodar we shall be able to produce on a site which grows quality II blue pine. This difficulty may well be considered by the statistical experts at the Forest Research Institute when preparing their yield table for *Pinus excelsa*, as the matter is one of much practical importance.

Cajander deals with all the auxiliary methods adopted by various experts and admits that, when supplementing one another, they furnish very good guidance in tracing growth curves, still they are of little avail for the classification of localities used for forestry. Methods based on the yield or heights of stands having, therefore, failed to solve the problem of the classification of localities, entirely new methods not dependent on mathematical or graphical abstractions had to be sought. In the words of Cajander "a natural system of classification is particularly necessary for silvicultural purposes, whereas for the purposes of forest mensuration, even somewhat more artificial systems may work fairly well. Silviculturally the different types of locality differ widely in value. To begin with the locality prescribes the species of tree to be grown. On the driest localities in Finland only the Scots pine stands any chance; on average localities the Norway spruce, birch and also the aspen grow satisfactorily, whereas

Alnus glutinosa and still more so the so-called hardwood species require the best localities in order to thrive satisfactorily. Furthermore, on different localities even the same species of tree requires widely different silvicultural treatment. Thus, for instance, the treatment demanded by Scots pine forest varies widely, depending on whether it is growing on dry heath (Class I), or on moist heath (Class II), or on hardwood forest land (Class III).

The differences of treatment are also applicable in the use of methods of regeneration; methods of improvement cuttings; in the growing of standards; in underplanting; and in the mixture of species; and these differences are really of fundamental importance. The proper treatment of Scots pine stands on pine moors shows a still greater contrast. In the interests of silviculture, therefore, a natural system for the classification of localities is essential. Until such a system has been evolved, there is small hope of any very extensive fundamental progress being made in the domain of silviculture. A system of silviculture, which takes no notice of localities, and at the present time silviculture in most cases is of this type, must be abandoned and replaced by a natural system of silviculture, based on locality classes. Also Mayr's grand idea of a universal silviculture seems to be possible of realisation only on such a basis. The numerous, often very ingenious local silvicultural methods that have been developed in various districts, especially in Central Europe, can only be made of general application with advantage, provided that the localities can be classified into classes which comprise localities biologically equivalent, and further, that the distribution of these classes and the natural classes of each local forest under consideration are known.

It is quite evident that the classification of localities for the purposes both of forest mensuration and silviculture should be based preferably on the same principles. In this way the foundation would also be laid for the many investigations connected with forest statistics, especially for those having some bearing on forest yield, and the need for such a uniform system of classification will be all the more urgent the more international forest statistics become.

From all the arguments discussed above it can be stated that :—

1. A natural, uniform, universal and international system for the classification of localities utilised for forestry purposes, is important from the point of view of forest mensuration and valuation and of forest management generally, of silviculture and forest statistics, as well as of forest policy, which to a great extent is based on the latter.

2. Such a system for classifying localities is indispensable also for all those forest investigations the result of which, in one way or another, is affected by locality.

3. This object, however has not been attained by the methods considered above; on the contrary, it must be taken for granted that the attempts to solve the problem, based on such methods, have failed.

Whenever the vegetation is sufficiently rank to induce a struggle and competition for space between different individual plants the latter combine to form more or less regular plant associations and, by reason of the law of the survival of the fittest, certain plant associations come to occupy certain definite localities and each of these communities possesses a vegetation of a regular composition and occupies a locality of a definite character. For instance Scots pine on dry sandy heaths with a rich *Calluna* vegetation, Norway spruce on moist lands with a rich *Myrtillus* vegetation. These forest plant associations are the foundations on which Cajander builds up his theory of forest types and his universal silviculture.

"The features of a plant association are generally determined by those species which are present in the greatest abundance and frequency. Those species, however, which are present at a lesser rate of abundance but are nevertheless, always or nearly always present are also of course, equally characteristic of the association. Finally those species which, though they may be more or less rare, are met with, however, almost exclusively in the association in question, are also characteristic of that association. On the other hand, of course, the absence of certain plant

species is also a very important feature in the delineation of a plant association, although the definite establishment of absence is more difficult."

"*Consequently all those stands are referred to the same* forest type the vegetation of which at or near the time of maturity of the stands and provided the stands are normally stocked, is characterised *by a more or less identical floristic composition* and by an identical œcologico-biological nature, as well as those stands the vegetation of which differs from that defined above only in those respects which—being expressions of differences due to age, fellings, etc —have to be regarded as merely accidental and ephemeral or at any rate as only temporary. Permanent differences call forth a new forest type in cases where they are sufficiently well marked, or a sub-type in cases where they are less essential, but, nevertheless noticeable."

By a study of the recurrence of *similar plant associations* under similar biological and climatical conditions it becomes possible to carry out a classification of plant associations, and areas occupied by the same forest type may be regarded as biologically equivalent. Hence it is possible to work out a biological basis of classification of localities essentially *independent* of species of trees—a basis which is necessary as a foundation for any method of classification of localities whether based on the soil or based on the yield of stands.

Cajander then proceeds to *classify* the forest types of Finland the guiding principle being that "the forest types should be grouped together according to their normal form (as expressed by the plant association which is characteristic for a mature and normally developed stand) and in such a way that those forest types, which, in respect of their floristic composition resemble one another most, are placed nearest to one another, and also in such a way that, in establishing the more comprehensive classes, notice is taken of the requirements of the species of trees and of the plant species usually growing in them, the order being as follows:—the Scots pine as the most accommodating species, the moderately exacting species and the very exacting species. Further account is taken of the relative abundance

of such physiognomico œcological plant types as lichens, mosses, plants with herbaceous stems, dwarf shrubs and bushes, and finally due attention has been paid to the general œcologico-biological character of the vegetation."

It is impossible for us to consider in detail the actual types distinguished but broadly the following classes are easily recognisable :—

I.—DRY MOSS AND LICHEN FOREST CLASS.

General character of the vegetation is xerophilous. Lichen vegetation nearly always present. Mosses in inverse ratio to lichens. Herbs and grasses scanty. In most cases the forest tree is Scots pine.

Cladina type.—Ground greyish white with Cladina vegetation (*Cladonia alpestris* in particular). Scots pine on poor dry sites.

Calluna type.—Moss vegetation (*Hylocomium*, *Ptilium* and *Dicranum*) with *Calluna vulgaris* the heather (ling) as the predominant species. Scots pine with commonly birch and spruce in mixture.

Vaccinium type.—Moss vegetation with plentiful *Vaccinium vitis idaea*, the cow berry and *Calluna*. Scots pine with birch and spruce the latter sometimes dominant.

II.—MOIST MOSS FOREST CLASS.

General character of the vegetation mesophilous. Moss vegetation fairly abundant or continuous, lichens insignificant, herbs and grasses present in greater degree, *Myrtillus nigra* (= *Vaccinium myrtillus* the bilberry) and *Vaccinium vitis idaea* prevalent.

Myrtillus type.—Moss vegetation abundant and continuous herb vegetation more common. *Myrtillus nigra* (= *V. myrtillus*) dominant nearly always accompanied by *Vaccinium vitis idaea*—Norway spruce the climax forest.

Oxalis Myrtillus type.—Moss vegetation present but scantier than in previous type, some grass, and herb vegetation

much more abundant *Oxalis acetosella*, *Melica nutans*, *Fragaria vesca* and *Rubus idaeus*. Hardwoods appear and at places *Quercus pedunculata* becomes dominant

III.—GRASS HERB FOREST CLASS.

General character of the vegetation hygrophilous Lichens insignificant, mosses scanty, grasses and herbs abundant and rich in species. Scots pine does not occur as a forest forming tree; in the most typical cases the forest is formed of hardwood species but in the types as they occur in northern countries spruce and broad-leaved trees with light seeds are generally dominant.

Many types in different parts of Europe can be distinguished such as the *Geranium-Dryopteris* type *Oxalis-Majanthemum* type, Fern type, *Mercurialis* type, etc

Sample plots were now taken in the different types and from these yield tables were prepared. The results show as was only to be expected that the better the forest type, the greater the mean diameter, volume, current annual increment, basal area and height, and the poorer the type the greater the number of stems to the acre. Since therefore growth in all its aspects is different for the different forest types while for the same forest type it differs within narrow limits, the forest types being uniform natural and relatively easily distinguishable quality classes are well suited to serve as a basis for the classification of forest soils for forest mensuration in general, and for yield tables in particular.

The next investigation was to compare the soil of the actual forest types, and Cajander shows that as the C A I decreases from 115 in the *Oxalis-Myrtillus* types (where 100 is the value of the C A I on the *Myrtillus* type) to 27 in the *Cladina* type so the C_aO and N decrease from 117 and 137 to 36 and 34 respectively.

From these and other investigations there is every reason to conclude that the forest types reflect the properties of the soil so clearly that these types may be adopted as a natural system of classification both for soils and forest crops

The importance of such a classification to the work of the Forestry Commission in Great Britain now becomes apparent

If by means of the existing vegetation we can classify the soil, and at the same time know the class of forest such soil will produce under natural conditions, much of the difficulties connected with the choice of species disappear. Once an area is allocated to the *Calluna* type Scots pine will be the species planted. If the area is of the grass-herb forest class either broad leaved trees or spruce, Douglas fir or larch depending on circumstances would be the proper species to cultivate.

Finally we come to the consideration of the forest types in relation to silvicultural systems. It is universally admitted that the natural regeneration of the Scots pine especially under the shelterwood or shelterwood strip system is most successful on soils of the *Vaccinium* type and that it is more difficult away from this type in both directions, —on the more productive types especially on account of weed vegetation, on the poorer types by reason of greater infertility and aridity. Under the same silvicultural system the regeneration of the spruce is most successful on the *Oxalis-Myrtillus* and the *Myrtillus* type. From this we pass on to the international aspect of silviculture in the light of forest types. How far is an internationally uniform system of silviculture possible of realization? Koppen has recognised a number of climate types, each of which is represented in a certain part and most of them in several parts of the world. Climate acts as the most universal locality factor. Parts of the continents characterized by the same climate, are populated by a vegetation the general biologico-œcological character of which is on the whole the same. Owing to the climate and the vegetation determined thereby, in the regions belonging to each climate type the soil forming process—weathering, leaching by water and formation of humus in the first place are identical in their main features though varying locally Similar types of forest are found in Northern Europe, the Alps, and in North America and the Himalayas. If any silvicultural system succeeds in one place there is every reason to suppose it will succeed elsewhere under similar climatic conditions as indicated by the same forest type but every reason to anticipate failure when applied to totally different forest types. Similarly in the introduction of exotics if care

is taken that a tree is transplanted from one forest type and planted on the same type in another part of the world success is far more likely than when no consideration is paid to this matter. Various types of forest can be recognised in the Himalayas, as in the forests of the Kumaon Bhabar, indeed everywhere in India different forest types are known to foresters but so far little has been done to work out a classification of types according to the different plant associations. Hole worked on this subject in the case of sal and showed that areas occupied by the grass *Saccharum Munja (munj)* were quite unsuited to sal whereas *Anthistiria gigantia (ulla* grass) indicated a soil suitable to this tree. A very vivid example of this can be seen on the fire-line in the Saharanpur division where the *munj* changes abruptly to *ulla* where the miscellaneous forest changes to sal. It is possible that a study of the plant associations would throw light on the correct species of tree to cultivate on different areas of *taungya* plantation, a matter which has been exercising forest officers for some years past and which, with the spread of clear felling and planting, has become of first rate importance. We consider Cajander's work one of the most important contributions which have been made to scientific forestry during the present generation and would welcome similar investigations into the various forest types of the different climates of India, their classification according to plant associations and the elucidation of the meaning of these different types. Such an investigation would go far to solve the ever recurring problems of natural regeneration which confront us at the present day.

FIRE-PROTECTION IN PLANTATIONS.

I have read Mr. Dawkins' reply in the November *Indian Forester* to my note on early burning in teak plantations with interest and am glad to find that he no longer believes in burning teak plantations.

Although there is but one paragraph in my note which could be taken as applicable to areas outside plantations—and this applies at least equally to plantations—Mr. Dawkins has widened the field of discussion to include the burning of forests in general and

in doing so has read my note through a distorting glass and ascribed to me pictures and statements of which I am not the author.

I prepared a detailed reply but I fancy it would be found tedious in print and unnecessary, as I think, from reading his note, that the real point on which we disagree is that Mr. Dawkins holds that a fire after growth has begun again is more harmful than one which takes place before growth ceases whereas my view is the opposite.

Apart from the numerous and obvious examples in the forest of vigorous recovery by young plants from the effects of a late fire, my reason is that all species (evergreen excepted, of course) which are now in existence have for centuries been exposed to nature's fires and nature has equipped them to withstand the effects of ordinary fires. Early fires are unnatural and the plants are not equipped to withstand them.

As Mr. Dawkins observes many species store food below ground in preparation for the next year's growth and, if my memory is not at fault, the botanists tell us that the storage of certain essential foods takes place just before the leaves fall. It is this period which Mr. Dawkins seizes for exposing the plants to the danger of destruction by fire.

Again he quite rightly states that "nature's fires are as irregular as anything can possibly be." In other words sometimes they take place and sometimes they do not, sometimes they favour one species and sometimes another. Hence our admittedly very mixed and understocked but nevertheless reasonably valuable forests. Mr. Dawkins wishes to substitute a regular firing of the whole forest every year at the earliest possible moment and thus upset the balance of nature. If he knew how to use early fires to improve the value of the forests we should all willingly adopt his system, but I submit that he does not know how to use it. I am not in a position, at present, to produce definite examples of the damage done by early burning in natural forests, and though in general I believe it to be destructive, the real basis of my objection to the system is that no one has ever closely studied its effects on an experimental scale. The burden of proof rests entirely on

the advocates of the system and I have never yet seen any favourable record of its results except generalities based mainly, I fear, on the wish being father to the thought.

The system of early burning was first recommended by Mr. M. J Slym in 1875 when he read a paper on "Jungle Fires" before the Rangoon Forest Conference. Mr. Slym seems to have disposed of the case for general and wholesale fire-protection very successfully—so successfully, indeed, that the President of the Conference declined either to permit the record of the paper or to give any reason for his refusal and Mr. Slym apparently had it printed privately.

After discussing the question of fire-protection Mr. Slym concludes "The collective inference I draw is that these fires should not be prevented *entirely* but the strength of them sufficiently lessened to lessen the harm. This can only be effected by firing the forests ourselves, two or three times during the dry weather, commencing in the beginning of February before the leaves are so thick on the ground as in burning to cause an injurious heat to the trees; while in each interval the quantity collected would be insufficient to cause any harm."

In commenting on the arguments in favour of fire-protection, Mr. Slym writes ' These views are naturally enough all based on commonsense but the pro and contra are nowhere sufficiently elucidated" but he fails to elucidate the pro and contra of his own proposal and merely bases it "on commonsense."

This is exactly where the early burner stands fifty years later, only he substitutes the expression "it stands to reason" —this is the only argument I have ever heard in favour of general early burning—for "based on commonsense."

We know that our forests were in existence long before we started reserving them and one has only to read Mr. Slym's notes of 1875 to be satisfied that they existed because of, or in spite of, fires. Although wholesale fire-protection was introduced there are large areas of reserves, both old and new, which have never been fire protected and yet the forest is still there.

This is, to my mind, the whole point. Our forests are not ideal but they were of sufficient value to reserve and they have under nature's treatment produced a considerable revenue and if any new system is to be introduced it is for those in favour of it to produce clear and definite proof that it is an improvement on nature.

Fire-protection was unquestionably beneficial in some respects just as it was harmful in others and such will doubtless be the case with early burning but I regard its wholesale introduction without the slightest knowledge of its effects as extremely dangerous.

What is it that the early burner is protecting and from what? I suppose the answer is that he is protecting the forest from damage by late fires. Has he ever stopped to consider what a forest is or what the damage by early fires may be?

A forest consists of mature and immature timber, poles, bamboos, saplings, seedlings, seed, the undergrowth, the soil, insects, bacteria, etc. The forest varies enormously often from acre to acre. Does the early burner really believe that it stands to reason that one supposedly simple operation is likely to prove beneficial to all parts of the forest under all circumstances? From the fact that his operations are of a wholesale nature I can only assume that he does, and in that case he is surely a most dangerous optimist. On the other hand if he does not believe that his methods of "protection" are a cure for all ills he is not justified in putting them into operation wholesale without previous detailed experiment to prove that he is not doing more harm than good.

Late fires do not always cover all areas but I understand that the early burner wishes to protect the forest by a complete destruction of all inflammable material every year. Has he proved that this annual "light fire" (I think this is the expression) is less harmful than a late fire at intervals? It is known that fire-protection increases the area under evergreen—it was known in 1864-65 according to Mr. Slym's note—is it certain that annual light fires will not increase the area under grass and dry forest?

Complaints have been heard that early burning is not always carried out as it is intended. Subordinates are said to leave the work until they can really get a good fire going. From the early burner's point of view a failure in technique of this kind is disastrous; he considers that a late fire does more harm than an early one yet here he is burning late and depriving the forest of any hope of escape. Has he ever carried out any experiment on a reasonable area to perfect the technique of the operation? The present system seems to be to give—or not to give—a subordinate a box of matches and tell him to run about vast blocks of forest and burn it where he can

I will give one instance of effects of early burning which, while it does not prove that early burning is dangerous, at least indicates the necessity for caution.

In a reserve on which a very large local population depends entirely for its bamboo supply, the middle is of ordinary moist deciduous forest with a good undergrowth of bamboo round and within which there is dry deciduous forest which on the ridge tops bears *in* (*Dipterocarpus tuberculatus*). Owing to fire protection some of the *in* regeneration had been ousted by bamboo which when I first saw it was about 30' high. Fire-protection had at that time been abandoned for some years and early burning had not, I believe, been carried out at all, certainly not during the two years I was in charge. I last saw this area a few months ago and noticed that the bamboos had been reduced to clumps of weak shoots of the year about 3' high. The Ranger informed me that early burning had been carried out for two years in succession. Here, I gladly admit, the effects of early burning were beneficial because the bamboo would never have been of much value and the *in* regeneration, which is very desirable, will soon be re-established, but I fear the instance cannot bring much joy to the heart of the ardent early burner as the benefit has been conferred (under certain circumstances) by the *destructive* effect of his pet *protective* measures. The *in* forest is of course much the same as regards early burning as the teak plantation for it consists of a fairly full stocking of large leafed deciduous trees

Lower down in the reserve, where the bamboo growth is good, the extraction of bamboo is very heavy and from February to April large numbers of villagers come in daily to cut and extract bamboos the maintenance of which is of the utmost importance to the well being of the local population. There are admittedly no large blocks of large leafed deciduous trees among the bamboos but is it certain that early burning along the ridges will not tend to reduce the area under bamboo? There are here and there groups of trees such as teak, *sinbyun (Dillenia pentagyna)*, etc., and in view of the results under *in* is it certain that the bamboo among and round these trees will not be killed off? Again the results under the *in* are immediately noticeable but is it certain that no harm is being done to the bamboo over the rest of the area? The results may be the same and equally sure only slower. The reserve has been exposed to natural fires, has been fire protected and again exposed to natural fires and the bamboo is still there as it is over vast areas which are exposed to late fires and it is now being burnt early on the assumption that "it stands to reason" that an early fire annually will do less harm than a later one which has not previously killed out the bamboo, even under the *in*, after a considerable period of fire-protection In my opinion a very grave risk is being taken

I maintain that it is up to the early burners to prove on a reasonable experimental scale that the early burning of the forest is beneficial and an improvement on nature and also that they are able to carry out the operation as they intend it to be done. I am not sufficiently optimistic even to hope that any one treatment will be found suitable under all conditions so that while they are about it they may as well find out where, when or how early burning is beneficial, either as an agent of destruction or protection.

G. S SHIRLEY, I.F.S.

REPORT ON A PAPER-PULPING RECONNAISSANCE SURVEY OF THE CHAKRATA FOREST DIVISION, U P.

BY W. RAITT, OFFICER IN CHARGE, PAPER-PULP SECTION, FOREST RESEARCH INSTITUTE, DEHRA DUN

1. I toured in the Chakrata Forest division from 26th September to 13th October together with the Forest Economist and examined all the principal spruce and fir areas and made visual surveys of several of the adjoining Tehri-Garhwal areas.

2. There are two methods in use for reducing wood to paper pulp, one, the *mechanical* method in which the wood is merely ground on stones to a fibrous mass. As no chemical bleaching can be applied and as the pulp must be white in colour only white woods can be used such as spruce and aspen, and spruce only where it happens to be almost free from resin as is the case with the Scandinavian and Canadian species. Knots, or branch-roots, in the case of spruce are troublesome as they will not grind to a fibre but break up into splinters which appear as yellow or brown specks in the finished paper. In the case of Canadian and Scandinavian spruce, these knots are yellow and not seriously objectionable and, compared with the Himalayan species, not very numerous. The larger ones are bored out, the smaller allowed to pass.

3. In the case of Jaunsar spruce, and the Himalayan species generally, the knots are much more numerous and very much darker in colour in consequence of the considerable amount of resin present. When young the trees are thickly branched down to the ground but as the tree grows these are suppressed so that the mature tree appears in many cases to be free of branches to 40 to 60 feet up, but their knots are there, overgrown by the later wood growth, not visible on the surface and therefore more difficult to deal with and they are intensely dark, almost black in colour. Probably up to 80 per cent. of the trees are infected by the peculiar red-wood in the centre which infects the Himalayan species generally. From measurements made, this red-wood amounts to about 40 per cent. of the whole tree and its colour renders it useless for a ground pulp. Finally, the white wood is

not all white, but contains a good deal of yellow in streaks, again an effect of the considerable resin contents. Mechanical pulping can, therefore, be ruled out of consideration. The wood is quite unsuitable.

4. The other method, *chemical* pulping, could be applied with success as has been shown by actual experiment in our own pulp plant. The defects mentioned above are not defects in this case. Both colour and knots can be effectively dealt with and, further, the silver fir can be brought in, thus adding considerably to the available supply, the proportion of fir and spruce trees being about 40 per cent. of the former and 60 per cent. of the latter. We shall, therefore, consider chemical pulping only. Our factory results are as follows :—

Mixed spruce and fir—Digestion by sulphate method.

Soda consumption	—25 per cent.	on weight of raw wood.
Bleach „	—5·62 per cent.	ditto.
Yield of unbleached pulp.	—38·78 per cent.	ditto.
Yield of bleached pulp.	—36·20 per cent.	ditto.

These figures compare well with average results obtained from American or Scandinavian wood and are for production of a white pulp. Quality of product is quite satisfactory.

The difficulties which face chemical pulping are those of *quantity and transport costs*. From the data available it would appear that the total sustained yield of spruce and fir together would not exceed 250,000 c.ft. per annum. This could be increased considerably in the earlier years of operation by clear felling those portions of areas which are within the deodar and blue pine zones, for replanting with these species as is now being done to some extent but this would only mean that the subsequent sustained yield would be reduced proportionately. The minimum output of chemical pulp or paper which would make an economic manufacturing unit is about 6,000 tons per annum which means 1,200,000 c.ft. of wood per annum. It is thus clear that Jaunsar alone cannot provide sufficient raw material but if Tehri-Garhwal were included in the scheme it would appear to be possible to get

enough wood to feed a plant of economic size. However before any definite steps are taken a detailed survey of the actual possibilities of the Tehri-Garhwal forests is essential.

6. The present methods of extraction are not only quite inadequate to handle such a large quantity of wood but they are also much too costly. Mr. C. S. Martin in his notes (August 1921) on Jaunsar is clear in his opinion that Jaunsar could be engineered for *logging* but that for Jaunsar alone it would not pay If Tehri-Garhwal were included, it would. If logging were carried out on this scale it would of course handle all useful species which, in turn, would involve a large conversion plant somewhere in the neighbourhood of Kalsi, comprising sawmills, papermills, seasoning kilns, box making and possibly wood preservation plant. These further involve waterpower and railway communication to main line at Saharanpur. The latter is under consideration and a survey has been ordered. A large combined plant such as this would have certain economic advantages, the most obvious being that the sawmill waste would no doubt be capable of raising steam for the steam using plants including digestion and drying in the paper mill, but such waste would not be enough to produce steam for power as well, the amount of which, at a rough estimate, I put at 10,000 H. P. About 15 miles above Kalsi on the Tons river there are several narrow rock bound gorges where damming operations would not be difficult and which could conceivably yield the power required. While on this subject I may mention a power site at Tajawala on the Jumna about 30 miles below Kalsi where the river drops down to plains level—but refer to it merely to rule it out of future consideration for the purposes now being considered. I have previously investigated this site in connection with another paper-making scheme. There is a fall of 40 feet which in minimum flow season would produce 6,000 H. P. not enough for such a scheme as outlined above and barely enough for a paper mill only But the serious objection is that the Eastern and Western Jumna canals take off at this place and the river training works necessary to divert a portion of the flow to a power plant and prevent interference with present canal headworks would be so extensive and expensive as to render the

proposal impracticable and would meet with strenuous opposition from the canal authorities. They had an example of what might happen again in the floods of September 1924 when their head-works were all but totally destroyed.

7. I am of opinion that under present conditions no pulp or paper-making scheme is possible but it may be useful to place on record what might be practicable under a logging and conversion project such as outlined above. We cannot give any figures of costs and profits on paper-making until it is known what the logging cost will be per c.ft. or ton of timber, including redemption of capital cost spread over a term of years, so confine myself to stating the terms and conditions with which, as regards paper-making, the project would have to comply.

I. I am of opinion that a Pulp or Paper plant could very conveniently form a section of a large general conversion plant and would, in fact, be a necessary part of it on account of the large additional volume (1,200,000 c ft.) of timber it would bring into the scheme and the effect this would have in reducing logging costs all round

II. The capital cost of the Paper-making part of such a scheme would be about Rs. 25 lakhs.

III. Spruce and fir timber to the amount of 1,200,000 c.ft. per annum would be required for a period of not less than 30 years and at a cost not exceeding six annas c.ft. at factory

W. RAITT,

Officer in Charge, Paper-Pulp Section.

THE ANDAMANS THEIR GEOLOGY FROM AN EASY CHAIR

The Andaman Islands have recently been attracting some public attention, that of the layman because of the vexed questions of their abolition as a convict settlement and colonisation by the industrious, though often unruly, Moplah, and that of the

"Junglewallah" on account of their rich and peculiar timber wealth. A popular account of what has hitherto been ascertained about their geological formations by the officers of the Geological Survey of India may therefore, be of interest to the readers of the *Indian Forester*.

If the reader will scan a map of the Indian Empire and succeed in discovering the Arakan Yoma mountain of Burma, he will find them running generally in a north and south direction, ending near Cape Negrais in the south. Continuing this smountain chain southwards into the Bay of Bengal with a little Itretch of imagination, he will pass progressively over Preparis sland, Cocos Island (where the ubiquitous "Emden" met with just punishment for her misdeeds in the early days of the Great War), the Andaman Islands and the Nicobars finally striking the north-west corner of the Island of Sumatra. This little attempt at map reading not only fixes our attention on the geographical position of our subject, a refresher often welcome, but is also suggestive of a fundamental geological significance which will strike the reader as he progresses through this article.

The Andamans comprise the North, Middle, South and Little Andamans and Rutland Island, together with numerous smaller islands included under the general name of the "Archipelago." The islands practically consist of low ranges of hills running generally in a north and south line, like the Arakan, Yomas the higher hills being nearer the east coasts, and the highest elevation, Saddle Peak, 2,400 feet above the sea-level. The slopes are generally steeper towards the east and this feature extends into the sea, indicating that the islands probably form the unsubmerged peaks of a submarine mountain chain. The coastline is much indented, more profusely on the east than on the west, the long meandering creeks being usually navigable almost to their tidal limits. The main drainage is eastwards in spite of the line of highest elevation hugging the east coast.

As one approaches the islands, the numerous coral reefs, fringing almost every coast are the striking geological features that meet the eye. Extensive mangrove swamps cover all but the most exposed parts of the immediate coast line, running

often times far inland, flanking the winding creeks (they have been estimated to cover from $\frac{1}{10}$th to $\frac{1}{8}$th of the total area of the Andamans). And except where clearings have been made by man, dense tropical jungle covers every inch of land from seashore to seashore.

Recent and sub-recent rocks.—The most recent deposits in the islands are the coral reefs previously noticed and still in the process of formation, and those of a calcareous tufa or travertine in an active state of deposition in certain petrifying springs, notably on Long Island and on Smith Island. The coral reefs that fringe the coast cease growing when they reach the low-water mark owing to the inability of the coral animalcule to live outside water. Their level is, however, quickly raised by sedimentation from the streams sufficiently to enable mangrove seedlings to take root, the roots of the mangrove, once established, assisting further sedimentation and the final emergence of the land level above high water mark. This gradual increase in the area covered by the mangrove is prominently noticeable in parts of Port Cornwallis. Thus is new land being gradually recovered from the sea before our very eyes.

Somewhat older are the raised beaches, sandy or coral, situated well above the present sea-level. They betray their former home by the existence of seashells, coral blocks and wave worn caves. A raised terrace, varying from a few yards to half a mile in width, may be observed along many bays on the east coast of the South Andaman. The terrace at Port Blair, over which stands the residence of the Officer-in-Charge of the Islands, must once have been under the sea. Near Hut Bay, in the Little Andaman, boulders of recent coral have been observed inland in a riverbed. Such phenomena, therefore, indicate a recent uplift of the coastal platform of the islands, correlating it with a similar upheaval along the Arakan Coast to the north and in the Nicobars to the south.

An interesting feature in connection with raised coral beaches may be observed in the Little Andaman. The natives of the island obtain their supplies of fresh water from cavities in the coral rock barely two feet deep and but little removed

from the seashore. The drainage of the interior percolates through the porous raised coral into the sea but its constant outward flow keeps it from contamination by the diffusion of the brine, though its underground level, as exhibited in these pits, waxes and wanes with the tide.

Against the elevations mentioned above, signs of what has been considered as subsidence have been observed elsewhere Trees which only grow in high forests have been noticed entangled in tidewash, but actually *in situ* Mangroves have been observed stagheaded over large areas, due to the rise of the sea-level according to some authorities (the excess of salt killing the mangrove), but owing to the stripping of their leaves by parroquets according to Mr. B B. Osmaston, a keen ornithologist. These phenomena can, however, be explained as due to local slips of the land surface towards the sea, without recourse to the theory of a general subsidence of land level. The geological structure of the Andamans is that of an anticline (a hump) the slope being steeper towards the east and continued as a submarine feature; it is, therefore, such as will allow of a subsidence of the coastal tracts into the sea, due to slips between the underlying strata.

Rocks of the Miocene age—As its name implies, the Miocene is the middle period of the Tertiary era, the last great geological era prior to the appearance of man on earth and characterised in Indian Geology by the upheaval of the Himalayas from underneath the sea. The shell marls and arenacious (sandy) limestones of the islands west of the Andamans (Paget, Interview, etc.) belong to a late Miocene age but rocks of this period are most abundant in the Archipelago, where they occur as grey and greenish clays interspersed with argillaceous (clayey) sandstones and limestone, similar to the Siwalik clays. Similar limestones appear occasionally in the streambeds of the Middle Andaman, as boulders or small outcrops of cream and grey colour. Together, they have been styled the "Archipelago group".

Eocene rocks are the oldest of the Tertiary era. Rocks of this age cover the largest area in the Andamans, either in the shape of conglomerates (pudding stones) or of sedimentary clays

and sandstones. Conglomerates are more abundant in the North Andaman, sandstones and clays predominate in the South Andaman, while the Middle Andaman accommodates all the three types.

The conglomerates grade from a coarse type down to the sandstones, the pebbles included in the matrix being generally rounded and waterworn, though anguiar breccia is not uncommon. The inclusions are, as may be expected, usually of older rocks and consist chiefly of red and yellow jaspers (opaque quartz), sandstones, quartzites, (metamorphosed sandstones), vo canic ash and basalts, and green serpentine. The matrix is more often sand than clay.

The sandstones are even grained, sometimes micaceous or calcareous, and varying in colour with the nature of the iron content, from green, through brown, to yellow. Pebbles of volcanic basalts and ashes are often found included, as in the green sandstones round Bonnington in the Middle Andaman. Intercalations of gypsum sometimes occur.

The clays of various shades of blue or green are often indurated and shaly, and occasionally include pockets or seams of coal of a jet black colour, as in the Bom-lung-ta valley of the Middle Andaman, but both the quality and the quantity of the coal leave much to be desired

From their included fossils, these conglomerates, shales and sandstones appear to belong to one series (known as the Port Blair group) which exhibit the greatest similarity to the Negrais group of the Arakan Yoma and the Laki group of Sind.

Pre-tertiary rocks.—The jaspers and quartzites already mentioned as occurring as pebbles in the Tertiary conglomerates and sandstones must obviously have been formed in pre-tertiary times. They also occur as outcrops in several places, together with a red porcellanic limestone. Outcrops of a soft calc-gneiss, a product of metamorphism of the older Cretaceous Serpentine, are also found.

The volcanic activities that produced these volcanic and metamorphic rocks might, therefore have occurred after the Creta

ceous Serpentine and before the tertiary sedimentaries. Similar included fragments have been recorded from corresponding formations of the Arakan Yoma.

Cretaceous rocks. Rocks older than the cretaceous—the age which produced those characteristic chalk cliffs that gave England her poetic name of "Albion"—are unknown over the Andamans. The cretaceous of the Andamans belongs to the "serpentine series and comprises many of the highest hills of the North, Middle and South Andamans, and practically the whole area of Rutland and Cinque Islands. In the North Andaman they cover an area of about 32 square miles round Saddle Hill as centre, in the Middle Andaman they are dotted about Mount Baker, Sound Peak and half a dozen other places, while in the South Andaman they occur round Bornatang, Protheroepur, Balughat and Rangachang.

The serpentine is a dark green hydrated silicate of magnesia with a little oxide of iron and alumina, and is a product of decomposition of olivine, a more complex igneous rock. It has a soapy feel and is easily scratched and weathered. A fibrous silky form is sometimes found, and is called chrysotile.

Corresponding formations in Lower Burma and in Java contain serpentine, which have been ascribed to the cretaceous age. The serpentine of the Andamans may, therefore, be considered as cretaceous.

Economic Geology.—The occurrence of coal and gypsum has already been mentioned Crystals of chromite have been found in the serpentine rocks but not in sufficient quantities. The coal and the gypsum are economically unimportant. The sandstones make good building stone and the corals furnish lime

The influence of geological features on vegetation and water supply.—The influence of the geological features on the water supply and, therefore, on the nature of the forest vegetation, has been profound. The serpentines constituting the highest peaks have, by their decomposition, produced a thick covering of rich soil, capable of retaining large quantities of water which is but tardily delivered. The streams that are born in the highlands maintain consequently a perennial flow of clear water and on the

The Pardhis.

slopes flourish a dense evergreen jungle, the home of the gurjan, bamboo and cane. The conditions are similar where the clays prevail But the sedimentary conglomerates and sandstones, being more porous, give rise to streams which are dry during part of the year, though such areas are also well-wooded. The prevailing type, however, is semi-deciduous, where the ornamental "Andaman padouk" reigns supreme. The change from one type to the other is often abrupt and striking.

T. V. AIYAR, P.F.S.

THE PARDHIS.

These men are of the tribe of the well-known travelling shikaris—the Pardhis locally called the Bil Pardhis.

They are very primitive, living out under canvas, relying on herbs for medicines, and begging or stealing from the villages near which they make a point of camping when their luck is out.

Their field of operation is the light open jungle and savannah land bordering Government forest. The methods they employ for trapping game are very crude but nevertheless effective. Buck, pig and partridge form their staple diet and does and fawns are trapped and eaten without the slightest compunction.

They work in pairs while trapping. On coming up to a herd of buck or pig one man lays a line of loops as shown in the photograph (Plate 4) across the general line of retreat. The herd is then slowly driven towards this, when the chances are one or more animals will get their feet caught by drawing the loops tight, and failing to uproot the whole line of stakes will at once be caught and trussed by the men.

The same method is employed for partridge with the apparatus shown on the right.

Each bamboo square holds a loop of horse hair suspended from the upper beam sufficient to admit the head and neck but not the body of the birds.

The birds are slowly driven up to the traps, then suddenly frightened so that they scramble through the enclosures regardless of the loops of hair which when pulled by the birds draw tight and hold them securely by the necks. It is by no means a sedentary occupation--the men often remain out in the field all day with little luck, the birds and animals soon get wise to the game and the attentions of the police keep them continually on the move. Most of them are ultimately imprisoned on account of their infringement of the game laws, their thieving habits, and the vow they have taken to live only by shikar.

C. McDONOUGH, P.F.S.

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(1) **FAUNA OF BRITISH INDIA, COLEOPTERA (CHRYSOMELINÆ AND HALTICINÆ.)** By S. MAULIK, 1926. *Taylor and Francis, London*, 30

(2) **BRITISH BARK-BEETLES** BULLETIN No. 8, FORESTRY COMMISSION LONDON, BY J. W. MUNRO, 1925. *H. M. Stationery Office*, 2s. 6d.

The publication of this volume (1) almost completes the treatment of the large and important family *Chrysomelidæ* in the *Fauna of British India* series: of the sixteen sub-families only the *Galerucinæ* now remain undealt with. The *Chrysomelinæ* and *Halticinæ* are of world wide importance as defoliators, both in the larval and adult stages, of economic crops, the latter

family possesses the remarkable power of jumping in correlation with a greater development of the hind-legs : hence the popular name of "flea-beetles"

In a short introduction to each sub-family the author gives a brief summary of the life-histories of a few known pests from various parts of the world and also two or three brief descriptions of typical larvæ. More than one hundred species are described by the author and names derived from Sanskrit are nearly always used : this method of nomenclature at least reduces the risk of adding to synonymy. A considerable number of these species are described from single specimens only. In some cases the type locality is not sufficiently defined, as for example where several widely-distant localities are listed for one species. The author has had evident difficulty with many of the species described by Motschulsky, the inaccessibility of whose types combined with his inadequate descriptions, prevents much more than a mere listing of his species.

A few miss-spellings of localities and of food-plants are present but are not worth mentioning here. In some cases localities are incorrectly listed, *e.g.*, on p 248, Darjeeling, Siliguri, etc., are in Bengal (as at present defined) and not in Sikkim. The work is well illustrated and the editing and production, as is usual in this series, leaves nothing to be desired.

It may not be out of place to mention here that the value of the *Fauna of British India* which is unexcelled by any other similar work in the world, is directly proportional to the amount of collected material available. The Forest Research Institute collections are of great importance in work of this kind and these collections are in turn largely dependent upon material provided by Forest Officers. The latter are reminded that all insects, whether *known* to be of economic importance or not, are much desired at Dehra Dun. In this connection it is interesting to note that a very large number of the species described in the above work were collected by H. G. Champion.

(2) Literature on Bark-Beetles is mostly in German and widely scattered. This Bulletin summarises in compact form available information on the systematics and biology of the

British members of the group. Even a beginner should have little difficulty in running down a species by means of the keys and numerous and clean illustrations. The portion of the book dealing with biology and with prevention and control of Bark-Beetle outbreaks is of great interest to forest officers in India: prevention is closely related with removal of slash and unhealthy trees which provide the most favourable breeding places for these beetles. India has hitherto been spared any devastating outbreak of these beetles but the forest officer has only to consider the appalling damage to coniferous forests by *Dendroctonus* species in North America to realise the importance of keeping these beetles in suppression.

The book is written in a clear and not too technical style and will be read with interest by non-specialists as well as by entomologists.

J. C. M. G.

SWIETENIA MAHAGONI JACQ EN *SWIETENIA MACROPHYLLA* KING. MEDEDEELINGEN VAN HET PROEFSTATION VOOR HET BOSCHWEZEN, NO. 15.

This neatly bound and admirably illustrated publication of the Dutch East Indies Forest Research Institute is a monograph on the two chief species of Mahogany: *Swietenia Mahagoni* Jacq. and *S. macrophylla* King. It contains thirty plates and a short summary in English of every chapter, as well as footnotes in the same language explanatory of all the illustrations and diagrams

As a full and detailed treatise upon true Mahogany, drawn from over fifty years experience of its cultivation in Java, where it is now one of the chief commercial timbers, this volume ought to be a contribution of considerable value to the general stock of scientific knowledge.

Mahogany has for many years been known throughout the world as the timber of a tree called botanically *Swietenia Mahagoni* Jacq, said to be a native of the West Indies and the adjacent coasts of Central America. The timber, under the name of

Spanish mahogany, became famous so far back as three hundred years ago for the construction of ornamental furniture, and it holds its reputation for this purpose to this day. The term mahogany, however, has come to be applied indiscriminately to other red-brown timbers possessing somewhat similar properties, some of which, such as Khaya, belong to other genera of the order *Meliaceæ*, while others being totally different families.

This confusion is due to the practice, common in the timber trade (and not unknown in other branches of commerce) of adopting a familiar name of long established repute for the introduction of a new species, often equally as good as its predecessors, but unlikely, through its very novelty, to overcome the prejudices of the market. Usually the adopted name is qualified by an adjective denoting the country or harbour of origin. To quote from this year's report on the Forests Department of Western Australia :—" It would appear that in certain overseas countries the name "jarrah" is inevitably associated with railway sleepers and paving blocks, and, to secure a footing among cabinet timbers, it may ultimately prove necessary to adopt some other trade name, such as " Western Australian Mahogany."

The true mahogany is furnished by different species of Swietenia, family Meliaceæ ; up to the present five species have been described, *viz.*, *Swietenia Mahagoni* Jacq. ; *S. humilis* Zucc. ; *S. macrophylla* King. ; *S. Candollei* Pittier. ; and *S. cirrata* Blake Of these only the two main species *S. Mahagoni* and *S. macrophylla* are dealt with in the report under consideration. As grown in Java it is found that there is little difference between the woods of the long and the short leaved types and both are regarded as equally valuable.

S. Mahagoni was introduced into Java in 1870 and *S. macrophylla* in 1888, and since then cultivation of mahogany has been rapidly spreading over Java In spite of a few failures, caused by the attack of the mahogany top-borer (*Hypsipyla robusta* Moore) the introduction of this species has been attended with complete success, and it is now grown in nearly all forest districts mostly in the plains, sometimes at a higher altitude up to about 3,500 feet above sea-level.

The morphological description of the flowers and fruit as given in the report need not concern us especially; but of rather more than passing interest are some facts recorded in the silvicultural notes on the subject of germination, in which numerous experiments have been carried out in the Forest Research Institute at Buitenzorg.

"The seeds were sown at a depth of one centimeter in five different positions, *viz.*, (*a*) seed with one of the narrow long sides downwards and the embryo upwards; (*b*) ditto with the embryo downwards; (*c*) seed with the wing upwards; (*d*) seed with one of the broad long sides downwards and (*e*) seed with the other board long side downwards. Similar tests were carried out with seeds that had been kept in storage for one or two months.

The conclusions for *S. macrophylla* are: heat (or light) has an unfavourable influence on the germination as it causes the development of crooked stems (especially when the seeds are sown according to method (*c*)—and, at the same time the percentage of germination decreased. The number of crooked stems was least and the germination per cent highest for the seeds sown on their long narrow side with the embryo upwards. Storage of mature seeds for a month has little or no influence on the germinability. Sowing the seeds at a greater depth than one centimeter has no favourable influence.

For *S. Mahagoni* the conclusions are: the method of sowing the seed has little influence on the germination power and the percentage of crooked stems; in general the percentage of germination was higher in the shade than in direct sunlight. Seeds with a low percentage of germination lose their viability rapidly in storage. Percentages of crooked stems are relatively low."

Professor Troup ("Silviculture of Indian Trees") has no details to give on the germination of either species. It may be interesting, however, to note the following extract from the Indian Forest Records ("Notes on Artificial Regeneration in Bengal," Vol. *viii*, Part *iv*, page 32) concerning the germination of *S. macrophylla* in India:

"The fruit ripens in February and early March and should be collected and dried for two or three days, then broken open

and the seed removed. Sow at once 3" apart on shaded beds with the wing of the seed sticking out of the ground."

In the Chittagong district where the introduction of the species seems to have been attended with the most conspicuous success the "tub" method of germinating the seed is employed. This consists of soaking the seed in a tub and drying it for 15 days. (Progress Report of Forest Research Work in India for 1920-21, page 23.)

It may be noted here that in Java the flowering time of both mahoganies is from November to January, and the fruits are ripe in June and July, while fructification generally begins as early as 12 to 13 years of age. On the other hand in India (Troup: Silviculture of Indian Trees) "the flowers (*S. Mahagoni*) appear in April or May and the fruits ripen from October to December." and (ibid. of *S. macrophylla*). "In South India it flowers from February to May and the fruits ripen from December to January." This variation may well be due to the difference in latitude, since Java lies between 8° and 10° south of the equator, a climate more tropical than any found in India except in the extreme south of the peninsula.

Both species produce abundant natural regeneration in Java, a characteristic shown chiefly in India by *S. macrophylla*, notably in Kaptai in the Chittagong Hills division, where we find that the young seedlings "come up in thick patches with perfectly straight stems, some of which are found to be already over 25 feet high at the age of three to four years." (Progress Report of Forest Research Work in India, 1920-21.)

In Java mahogany is regarded as of secondary importance to teak and therefore in the teak region it is only planted occasionally and in pure stands to embellish the forest. Nor does experience seem to point to it as a suitable species for underplanting the teak. This conclusion is endorsed by Bourne (Working Plan of Nilambur) as the result of experiments in this connection with *S. macrophylla*.

Experience in Java favours the adoption of Mahogany on poor soils unsuitable for teak, where a mixture is recommended of mahogany planted (or sown) in alternate rows with some other

species such as *Cassia siamea* with *Leucaena glauca* as a soil cover. In India it has been found (Troup: Silviculture of Indian Trees) that mahogany in dry climates and on poor soils is a complete failure. The tree thrives best in a moist warm climate on deep rich soil which should not be stiff. The difference in these conclusions may be due to the fact that in India mahogany grows somewhat outside its optimum, and is therefore more exacting in such circumstances than in the moist, tepid fecundity of Java.

Both species of this tree tend to branch greatly, and a narrow spacing of plants is therefore, recommended. The results of this closer planting are shown in Java by a greater volume production per acre for mahogany than teak, but similar graphs for height growth, given in the report, indicate that both species are slightly slower in most cases in their height growth than the former, but this may be due to the fact mentioned above of mahogany being generally confined to the poorer soil qualities. In India the growth in both height and girth has been phenomenal for both species, where their cultivation has been at all successful, and specially so for *S. macrophylla*, artificially regenerated in Chittagong. "By the end of the first rains they attain a height of 2 to 3 feet; in two years 8 to 10 feet and in three years 18 to 20 feet" (extract from "Artificial Regeneration in Bengal." Forest Records Vol. viii, part iv.)

In this region, which seems to be that in which the species has been most successful in India it has been decided to grow it in mixture with some shade bearing species of a similar rate of growth. So far *Cedrela Toona* and *Chickrassia* seem to be the most promising species for that purpose.

Of the two *S. macrophylla* seems clearly indicated as the more suitable for Indian conditions. *S. Mahagoni* has in most cases been a failure in this country. It has thrived better when grown in gardens than in forest plantations, and this result is attributed by Prof. Troup to the greater attention and protection from insect and other enemies it has received in such places. *S. macrophylla* is evidently more hardy and less exacting.

Both species seem to be equally exposed in Java, and also to some extent in India, to the attacks of *Hypsipyla robusta* the mahogany top-borer. Although this pest never causes the death of the attacked trees, the development of the trees may be retarded by it to a considerable extent, and the shape may be seriously affected. The most effectual preventive of this pest is considered to be, in Java, mixture with another species which forms a shelter to it, this protection being due partly to the mechanical hindrance afforded to the moth in its search for young mahogany tops on which to deposit its eggs, partly to the fewer mahogany trees on the same area as compared to pure stands and partly to the fact that an affected tree will have less opportunity to ramify in such circumstances and consequently the damage will be less.

At this stage of their cultivation it may be very difficult to expect any very definite conclusions as to the system or systems of management that seem most suited for this species; nevertheless it is regrettable that the author has not furnished us with a rather fuller discussion of this subject, together with some data as to the rotation adopted at present in the Dutch East Indies or contemplated in the future.

H. P. D.

EXTRACTS.

NOTE ON THE CONNECTION BETWEEN THE IMPERIAL FOREST RESEARCH INSTITUTE AT DEHRA DUN AND THE RAILWAYS OF INDIA.

(Reprinted from the Quarterly Technical Bulletin of the Railway Board.)

A large part of the work that has been and is now being done in the Economic Branch of the Forest Research Institute is for the direct benefit of the Railways of India as much as of the Forests, and that this is not understood by a certain number of Railway Officers is evident.

The intention of the present note is to make clear to the readers of this Bulletin what exactly are the activities of this

Research Institute, and to emphasize the fact that problems of any sort connected with the uses of timber will be willingly investigated by the experts there on receipt by the Forest Economist of particulars of what is required.

The equipment of the Institute is, as far as it goes, complete and up to date. In the Timber Testing Laboratories eleven electric machines of great power and extreme accuracy are installed. The most powerful of these work up to 100,000 lbs. and the instruments for observing strain are sensitive to 1/20,000th part of an inch.

The Timber Testing workshop is in charge of a very experienced and highly qualified expert, and complete strength data, of undoubted accuracy, are obtained for every timber investigated. Up to date some thirty-three timbers have been tested, and the work is progressing rapidly. Additional machines are now being installed and additional staff is being engaged so that the outturn may be still further accelerated.

The results of the work done in this Section are shown on rotary indices for ready reference, which may be obtained on application to the Forest Economist by those interested. They are of two types; the one is popular, showing the strengths of various timbers in terms of those of teak taking the latter as 100 in all cases; the other is technical giving the data in engineering terms.

In this connection the railways are directly interested in that they are enabled to select timbers for their various purposes which may have the same strength characteristics as teak, in the particular direction required, and yet may be considerably cheaper.

At the present time a very extensive study is being made of all Indian timbers likely to prove satisfactory for use as railway sleepers, including tests of spike holding power, and lists are being prepared showing which woods make the best sleepers, and how these woods compare with foreign sleeper woods. The same kind of work is being done in the United States Timber Testing Laboratory, and lists are being prepared in the same way. Thus comparison between Indian and American sleeper

woods is facilitated and in this connection it is interesting to note that if creosoted Indian *Terminalia tomentosa (sain, asna, matti* or laurel wood) be placed in the American list it takes *second place*, being surpassed only by black locust *(Robinia pseudacacia)*; it stands well above white oak *(Quercus alba)*, one of the most highly valued sleeper woods in America; and the figure expressing its sleeper value (in quality, but not in price) is more than double the figure for Douglas fir *(Pseudotsuga mucronata)*.

In addition to this special investigation of sleeper woods the routine strength tests made will have a direct bearing on the usefulness of various timbers for railway carriage and wagon building. A further reference to this matter is made below.

In the Wood Preservation Workshop vastly the greater part of the work done to date has been solely for the benefit of the railways, and has consisted in experiments on the impregnation of sleepers of various timbers.

In a short review of this description it is not possible to detail the timbers investigated and the results obtained. A full report on this was included in the note on sleeper supply submitted by the Forest Economist to the Annual Meeting of the Standing Committee of Chief Engineers in July last which has already been printed and circulated, it is understood, as a technical paper, by the Railway Board.

This Section which is in charge of a most experienced and, at the same time, scientifically accurate officer is ready to deal with any problem that may be presented to it in connection with the impregnation of timber, and all enquiries in this connection are welcomed and should be addressed to the Forest Economist.

Up to date the experiments made have had a concrete result in the erection of a big creosoting plant at Dhilwan by the North-Western Railway, where a large number of *chir (Pinus longifolia)*, *kail (Pinus excelsa)*, silver fir and spruce sleepers are annually treated.

It may not be out of place here to emphasize once again the fact that the creosoting of spruce and silver fir, without previous incision is liable to give bad results, and is looked on with grave misgivings by the Forest Research Institute, inasmuch as

the failure of these species in, say, some seven to twelve years from now when the details of their treatment and even of their names will possibly no longer be traceable, would be more than likely to lead to the damning of all soft woods other than deodar. It is understood that in consequence of these representations an incising machine is being installed. With this supplementary treatment there seems to be no reason why these two species should not prove quite satisfactory.

A further result of the activities of the Research Institute in this direction is found in the decision of the recent conference at Shillong, of those interested in the Eastern Sleeper Group, that the installation of a creosoting plant in Assam is desirable. One or two points still await further consideration but it seems clear that this plant is necessary and will be installed in the not distant future. Some five species of common occurrence in the Assam forests have been accepted by the Dehra Dun Research Institute as suitable for sleepers, if treated, and some half dozen or so more which are still under investigation, give every promise of being so. Of these species there are sufficient to give a sustained yield of a good many lakhs per annum, but here labour difficulties come in, and at present the Forest Department is not able to guarantee more than a minimum of two lakhs per annum; it is quite likely, however, that this number can without difficulty be largely exceeded.

Apart from the question of sleepers this Section is ready to deal with problems connected with the impregnation of various timbers for use as floor boards and other parts of railway carriages if this is considered necessary, and for telegraph poles, paving blocks for platforms, etc., etc.

Apart from the impregnation of timber its seasoning is of great importance, and this matter is, again, dealt with by another expert, an officer with some 20 years' experience in timber drying under every variety of climatic condition in many different parts of the globe. The investigations are in two parts, air-seasoning and kiln-seasoning At present all sleepers are *air* seasoned before impregnation. This is necessary owing to the fact that *kiln* seasoning of timber in such thicknesses would take several

months to complete and the cost would, therefore, be prohibitive. It is hoped, however, in the near future that a new type of kiln will be installed patented by a Swede of the name of Forselles which is capable of seasoning sleepers in 48 hours and less. This has been actually demonstrated with Indian timbers in Sweden recently under the supervision of the Institute's expert.

Should this process prove satisfactory it will greatly cheapen the cost of the finished sleeper, as it will eliminate a large amount of degrade, which at present necessitates the rejection of quite an appreciable percentage, and will further eliminate the necessity of ocking up capital for the long period that is now necessary when sleepers have to be air seasoned for a year to eighteen months, as is now the case. The sleepers received for investigation at Dehra Dun are at present stacked for air seasoning in big airy godowns, and here the moisture content is determined at regular intervals until the sleepers have arrived at a suitable condition for impregnation, that is to say, with not more than some 15 to 20 per cent. of moisture.

From this, data is obtainable for the length of time the various timbers may be expected to take to arrive at optimum condition. Apart from this further experiments in air seasoning of sleepers are being initiated in various parts of India, under the control of the local Forest Officers, for the same purpose.

Thus it is seen that the three Sections of Timber Testing, Wood Preservation, and Seasoning are, and have been for several years past, all interesting themselves in the question of the production of sound cheap sleepers of timbers other than teak, sal, deodar and *pyinkado (Xylia dolabriformis)*.

The Section of Seasoning is further involved in an investigation of the problem of kiln seasoning planks and scantlings, of a variety of woods, for building railway carriages and wagons. Some 200 tons of timber from all over India, Burma, and the Andamans is now arriving at Dehra Dun and is being sawn to sizes, kiln seasoned and sent out again to the various Carriage and Wagon Shops for building into their vehicles These are going to be kept under observation for some years so that reliable

data may be collected as to the behaviour of the different woods tried, and the different degrees of seasoning attained.

In addition to this, four coaches are to be built at the Lillooah Railway Workshops in 1927, 1928 and 1929, under the orders of the Railway Board, of timber selected by the Forest Economist, converted at Lillooah, transported to Dehra Dun during the monsoon,—to avoid degrade,—and kiln dried there free of charge.

Two of these coaches are to be built, if possible, of one timber each; the other two will be of various timbers. The object of this investigation is to demonstrate the suitability of timbers other than teak, which is expensive, for railway carriage and wagon construction. If successful it will save the railways of India many lakhs of rupees per annum.

In the Wood Workshops, which again are controlled by an efficient, experienced and highly qualified officer, experiments, which it is hoped will be of benefit to the railways, have already been conducted and others are in contemplation.

The Research Institute is convinced that plywood can replace solid for many purposes in railway carriage construction. The failure of this material in the past does not alter their opinion, as the results of their own work have stood up to adverse conditions with the greatest success, even though those of others may not have done so.

The East Indian Railway has recently put on the road a new dining saloon panelled with sissoo *(Dalbergia Sissoo)* plywood made up in these workshops.

The problem with this material is to find a glue that will withstand the effects of the variety of climates which may be met with, in the course of 24 hours, by such a vehicle travelling in India. Far higher efficiency is necessary here than in Europe or America, but the research is progressing and it is hoped that a really satisfactory adhesive medium will eventually be evolved even if that at present used does not give the results which we expect and look for from it.

In the coaches referred to above, that are to be constructed at Lillooah, various types of plywood will be used for a part of the panelling, which, if it does fail, can be readily replaced without undue expense.

It is hoped that this short note has shown that the Economic Branch of the Forest Research Institute at Dehra Dun is ready to take up, and is fully equipped for any investigation into problems in the uses of timber that may be submitted to it. Further, the accuracy of results published is guaranteed, and no consideration of the desirability of marketing Indian woods is or ever will be allowed to bias the decisions arrived at by the experts at this Institute, who are Scientists before they are Foresters. *(The plates have not been reproduced—Hon. Ed.)*

CO-OPERATIVE TREE PLANTING.

A gradual change in the general prairie landscape is taking place in Western Canada as a result of the co-operative tree-planting work being carried on by the Forestry Branch of the Department of the Interior, says the *Canada Lumberman*. This change is particularly striking to those who are familiar with conditions as they existed in Manitoba, Saskatchewan and Alberta some 25 or 30 years ago. Thousands of shelter-belts have been established from seedlings, cuttings and transplants distributed from the nursery stations at Indian Head and Sutherland, Sask. The work has grown to such proportions that during the spring of 1926 over 5 500,000 seedlings and cuttings of such varieties as maple, ash, caragana, poplar and willow, were sent out. In addition to these, broad-leaf varieties over 50,000 evergreens, spruce and pine trees were distributed at nominal cost for general farm planting, and about 60,000 for planting on forest reserves in Manitoba and Saskatchewan.

During recent years the distribution has been carried on from two stations. Indian Head making shipments to Southern Manitoba, Saskatchewan and Alberta, and Sutherland to the northern districts. Careful check is kept of all material sent out until the plantations can be considered as fairly well established

and no trees are allotted to an applicant until inspection and enquiry indicate that the land has been properly cultivated in preparation to receive the young trees. In most cases special plans are prepared in the office of the Tree Planting Division at Indian Head during the winter for the guidance of the individual planters in the spring. This season some 3,297 plans were so prepared.

The effect of tree planting on the social and economic life of the prairie province is considerable. Shelter-belts have made the homestead more home-like and comfortable, while, by checking the high prairie winds and conserving moisture, the production of the farm is increased. The farmers of Western Canada quickly realised the value of planting trees, and in the large and steady demand for material is seen their approval of this important work.—(*Timber News*).

TAXODIUM DISTICHUM.

The American bald cypress (*Taxodium distichum*) known also as red, black, yellow or white cypress, is a tree of very ancient geologic lineage. The cypress and its relatives at one time covered the entire northern temperate zone of Europe and North America extending up into Greenland and almost to the northern tip of the Asiatic continent. In those days, when the climate was much warmer in those northern countries, the tree occupied the hills and valleys. In those early days the cypress was one of the trees commonly found on the shores of the Mediterranean Sea. With the advent of the Ice Age the cypress disappeared from many of its former haunts. It, however, left traces in the form of wood now found as fossil, or more frequently in the form of cones or leaves, so the geologist is in a position to trace back and determine with considerable accuracy in what regions the tree formerly flourished.

In the United States the tree formerly grew over practically the entire area, going as far south as Central Mexico Remains of comparatively recent cypress forests are found in numerous swamps, particularly along the present coastline. Many of these have been discovered in Maryland and Virginia, where stumps

8 ft. to 10 ft. in diameter have been uncovered. Similar ancient cypress remains are found in southern Louisiana where they are uncovered in dredging operations.

At the present time cypress, unable to meet modern conditions among which the competition of more modern races is undoubtedly a factor, has been crowded from the hillsides into the swamps, and is to-day distinctly a swamp tree growing along the Atlantic and Gulf coasts and up the Mississippi Valley. In these swamps it grows associated with tupelo and other swampy species.

Manufacture of Cypress.—It is into these swamps that the lumberman has to penetrate, and under difficulties unknown, and frequently not appreciated by the northern millman, he gets out the cypress logs The water in these swamps is frequently present the year round, although in many cases the swamps dry out during the summer period. In logging cypress the trees are usually girdled during the latter part of the summer or fall in order they may dry out during the winter period to facilitate the process of floating. After they have stood in this girdled condition for some months the trees are cut down. The cutting off of a large cypress tree is probably as difficult an operation as one could imagine, owing to the fact that the trees usually have a very swollen base, which necessitates cutting it a considerable height above the ground. After the trees are cut they are taken to the sawmill either by being rafted down the rivers or canals or by logging trains. They have to be pulled usually by means of small donkey engines, whose cables usually go out from one half to three-quarters of a mile into the swamp. Any one who has ever witnessed the operations in a swamp of a cypress lumberman, and has shared the privations of life in these regions, realises that the expense of this part of the operation must be very great and is consequently not surprised when the ultimate price is quoted to him.

Most of the trees which are cut are very old some of them reaching the age of 1,500 to 2,000 years. In the older cypress brakes many of the trees are hollow, necessitating the cutting off of a considerable portion of the trunk.

After the logs have been brought to the mill they are dumped into a pond and are carried from the pond into the mill in the usual manner and sawn into various grades of lumber. One element enters into the sawing of cypress logs not usually found in other woods; that is a very large percentage, particularly of the older logs, are affected with a peculiar disease known as "pecky" or "peggy" cypress This "pecky" cypress is in reality very valuable, but the presence of the disease in a large log means that sometimes half the log has to be manufactured into low grade lumber or ties. One of the characteristics of the modern cypress mill is the manner in which every part of the cypress log is manufactured into something The manufacturer practices conservation in a very high degree

After the lumber is sawed it is dealt with in a manner characteristic to most woods; that is, the higher grades are air dried, and then go through the planing mil for further manufacture. It is a characteristic of most cypress mills that they use great care in the subsequent handling of their lumber after it is sawn. In order to assure equal drying and freedom from checking the end crossing strip on the side of the pile exposed to the sun is usually made of a wide board which is allowed to project out beyond the end of the planks so as to cast a shadow on the ends of the planks, thereby reducing the tendency to check. Cypress lumber is free from many of the ills which affect other woods. Aside from the pecky disease referred to (which is in reality not a defect for many uses) no disease of the wood is known. After it is once piled it is subject to little deterioration.

Characteristics of Cypress — Cypress is a typical coniferous wood. It varies in colour from light almost white, such as that found in its northern region in Arkansas, Tennessee and Missouri, to almost black such as is found in many of the cypress brakes in southern Louisiana and Florida. It is usually reddish yellow and sometimes greyish brown, with the sap wood considerably lighter in colour than the heart wood. The terms white, red, black cypress, etc., are localised names given to cypress growing in different regions. From the standpoint of the user they have little practical significance because there is no method known to fully differentiate one from the other.

The colour seems to be an accident of the location in which the tree grows, although it is generally true that the darker coloured wood is found in what are known as tide water swamps that is, those located within 200 miles of salt water. The lighter coloured wood comes from swamps to the northward. As will be indicated in discussing the lasting power of cypress, colour is of significance only when taken in connection with the percentage of heart wood found in the tree. Common usage has applied the term red cypress to the tide-water form because of the preponderance of its red colouration. This tide-water cypress is usually red or darker and has a very fine even grain, is frequently marked by various coloured zones darker or lighter in colour than the main portion of the tree, which oftentimes extend for great lengths throughout the trunk. Cypress wood is one of the lighter woods, weighing approximately 50 per c. ft. when green, although in some cases it is as high as 60 lb. per c.ft. Its specific gravity varies from 0·35 to 0·60; the average may be taken as 0·45 for dry wood, equivalent to 28½ lb. per c. ft. or 48 lb. per c. ft. when green. These figures should be taken as broad averages because the trees will vary as to weight depending on the rate of growth and the region in which they are found. In drying cypress shrinks with considerable uniformity. In rate it stands about between the heavy and light pines. On an average it may be stated that the shrinkage from absolutely green wood to absolutely air dried wood is about 8 per cent. in volume. Its strength like its weight is intermediate between heavy and light pine. Tests made by United States Forest Service indicate a strength of dry wood (9 per cent. moisture) as follows :—

Under static bending the modulus of rupture	11,300 lb.
Modulus of elasticity	1,540,000 lb.
Compression perpendicular to the grain	910 lb.
Shearing strength parallel to the grain	1,080 lb.

Cypress wood has practically no odour or taste nor does it impart any odour or taste to materials which come in contact

therewith. This was very well illustrated when the manufacturers of cypress exhibited some barrels made of cypress some years ago in a competition for a prize given by the National Irrigation Congress for the best substitute for oak barrels to be used in shipping wine. Among the chief requisites for a barrel of this kind was that it should impart no colour or taste to the liquid contained therein. An exhaustive series of tests were made with cypress and other woods, and it was found that of all the woods examined cypress was the only one that did not in any way change the liquid contained in the barrels. The prize was unanimously awarded to cypress. Cypress wood, in other words, is chemically inert, which is of course of very great advantage in the manufacture of all kinds of cisterns, tanks and other liquid containers. Cypress wood is very easy to work,—that is, it is soft and has a very even grain and takes a beautiful finish.

One of the chief qualities of the cypress wood is its resistance to decay. In this respect there is practically no wood superior to cypress. It has certain antiseptic elements in the wood which protect it for long periods of time against fungus decay Instances showing the great lasting power of cypress are so numerous that volumes might be written thereof. Attention is called, however, to the fact that this property of decay resistance is specifically the property of the heart wood In its most marked form this decay resistance property is found in the tidewater trees. The very slow growth makes a dense wood, and it is this particular grade of cypress—that is, the cypress growing within 200 miles of salt water—which has the decay resistance of the highest degree.

Ordinarily wood destroying fungi do not decay cypress heart wood for many years. This remarkable property is made particularly striking under conditions of high humidity and high temperature such as is frequently found in greenhouses. The remarkable decay resistance of cypress heart wood is shared by the so called pecky cypress. To most people looking at a plank of pecky cypress with its numerous holes the wood has the

appearance of being in the last stages of decay. In reality the pecky cypress has very remarkable decay resistance qualities. It is for this reason that pecky cypress has been used for many years in the manufacture of railroad cross-ties, fence posts, side-walks, planking, etc. Pecky cypress cross-ties are found in every railroad in the south. Planking of pecky cypress makes one of the chief side-walk materials of the south. It is also used for sewer lining where, in spite of alternate wet and dry conditions, it serves perfectly. Where strength requirement is not material and lasting power requisite pecky cypress will be found of the greatest service. It has recently been used for interior work because of its peculiar appearance.

Summing up the characteristics of cypress wood it may be briefly stated that it is a soft wood with even grain, sometimes with beautiful figuring, which is easily worked which shrinks very little, which has an average strength, imparts neither odour, nor taste to materials coming in contact with it, checks and splits very little, and is noted for the great durability of its heart wood.

The above article which is from the pen of Dr. Hermann von Schrenk, is issued by the Southern Cypress Manufacturers Association, Poydras Buildings, New Orleans, Louisiana.—[*The Timber News.*]

DEVELOPMENT OF FORESTS OF THE TEHRI STATE.

H. H. the Maharaja of Tehri is taking a keen interest in developing the forests of his State. The State forests are so rich that if properly developed under an effective organization, having regard to new scientific methods of exploitation that are being discovered every day in the advanced countries of Europe and America, they can yield a very large revenue to the State, which in turn can help to a great extent in developing the other resources of the State. And we are glad to note that the question of the improvement of the State forests is receiving the attention of His Highness in the manner it deserves. The forest department is being gradually brought under the efficient control of offi-

cers, who have received training in foreign countries and have the status of Indian Forest Service Officers. Mr. Mobbs, I F.S., is in charge of the Tons Forest division and during the short time he has been in charge of the division he has through effective and efficient organization, brought it under proper control. Pandit Padma Dutt Raturi, M Sc. who passed the I. F. S examination in England with honours and stood first in the competition, is working under Mr. Hopkins at Chakrata. Mr Ramanand Saklani, another student sent abroad by the Durbar to specialize in forestry, returned the other day from America after receiving his M F. degree (Master of Forestry) at the Yale University. Mr. Saklani spent five years in America and Europe and studied various latest methods of exploitation as are in operation in different countries. With such a band of forest officers in Tehri State, the State forests, we can confidently say, are bound to make marked improvement in the near future. [*The Dehra Chronicle.*]

A TAX ON GOATS.

FASCIST GOVERNMENT'S NEW LEVY.

Milan, Jan. 6.

After the bachelors, the turn has come now of the goats, on which the Fascist Government yesterday decided to put a new tax.

The thing may at first seem strange. Why a tax on goats? Surely not because the nimble animals are animated, according to La Fontaine, by a "certain *esprit de liberte*," nor because they deserve the reproach made against the bachelors of being useless to society. Quite the opposite. Goats were rightly defined the "cows of the poor" because they yield proportionately more and richer milk than cows and cost their owners much less.

The explanation and justification of the tax are given in to-day's *Corriere della Sera* by a well-known expert in rural and agricultural problems. Goats, he tells us, are very useful if kept in stables or closely watched when in the open; but they may do a lot of harm if left free to browse upon anything they like. It seems, for instance, that they are responsible for the slow process of deforestation on the mountains of the South. Hence the

advisability of State intervention in order to control their movements Goats will no longer be allowed to pasture in certain places if their owners have not previously taken out a special licence and paid a tax of ten lire per head.

Italy, after the Balkan Peninsula, is the country in Europe that has most goats—about *18 to every square mile. It is* reckoned that the new tax will be applicable to 2,450,000 head. Its yield, however, will not be so large as that on bachelors. And this, of course, is a just and consoling distinction left to the latter.—[*London Times*].

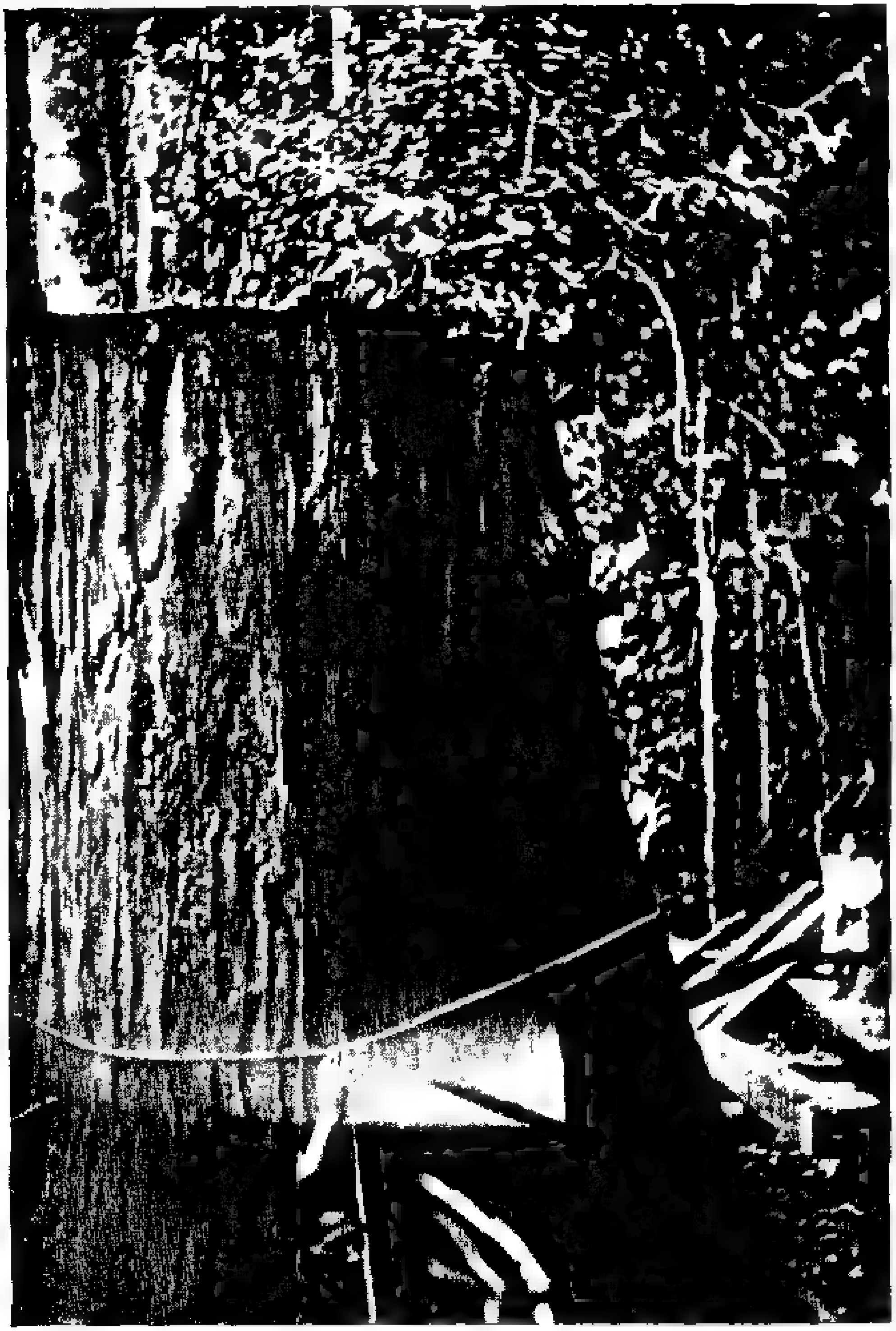

Photo by Luang Abhipa. Prason, Siamese Forest Service.

Fig. 1.—*Balanocarpus* sp. 17' girth at 7 ft. 8 in. from the ground, total height 180', clear bole 66'. (Tree just felled showing high stump).

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AGRICULTURE AND FORESTS IN INDIA.

"And He hath appointed the balance
that in the balance ye should not transgress;
weigh therefore with fairness
and scant not the balance."

Al Furkan,
or The Illumination.

In the issues of "Capital" for March 31st and April 7th appears an article under the above heading which deals with the grievances of the ryot against the Forest department.

The burden of this article is the formation of village forests with which forest officers have nothing to do, the increase of grazing areas and the removal of other restrictions. Before dealing with these several points we must refute the accusation that forest officers have no sympathy for agriculture. Many of us are as intimately connected with the land and its cultivation as the author of the above article claims to be: our life is spent amidst an agricultural population and in rural employment, far from towns and the clamour of politicians: the forest staff and labour are recruited from an agricultural stock and what little society we have is connected with crops and weather. Under these circumstances is it reasonable to suppose that the forester is an enemy of the ryot, seeking at every turn his destruction? the contention is absurd.

The aim of the forester in dealing with grazing questions is a reasonable compromise, whereby the grazing of cattle is excluded

from the limited area under regeneration until such time as the young trees have grown up and cattle can be again admitted without damage.

Thus forestry is possible and the restrictions placed on grazing not unreasonable, the forester has weighed with fairness. The author attacks such restrictions, he therefore supports the claim that the interests of grazing are of more importance than the maintenance of forest, he is prepared to see the degradation and ultimate destruction of the forest, he has transgressed the balance.

Let us consider firstly the village forest as it exists in fact and not in imagination. The forester has no objection to surrendering such unprofitable areas, he merely states his opinion that they are condemned to destruction. What is happening to the areas of class I forest in Kumaon, excluded from the management of the Forest department as the result of political agitation? Their destruction is in rapid progress Large areas in the Kangra district were made over to the management of the Civil authorities some years ago; the destruction of these areas has been accelerated The forests of the Punjab Siwaliks have never been under the Forest department and have been village forests in which the people grazed and cut and lopped. This policy has been responsible for great loss to the cultivators of the soil in the Hoshiarpur and Ambala districts, where fertile corn fields have been turned into stony wastes On the other side the afforestation of the ravine lands of the Etawah district by the Forest department and the management of these areas as fuel and fodder forests has been of incalculable benefit to the local agricultural population.

In the United Provinces the areas which are more suitable for grazing than for timber production are allotted to a separate working circle for management as grazing areas; elsewhere in the Central Provinces the grazing management is one of the most important features of forest working plans and is settled in consultation with and approved by the Civil authorities. We have no personal knowledge of the Madras village forests but we state without any fear of contradiction that in Northern India areas

of forest made over to the *uncontrolled* management of villagers are handed over to destruction.

Our author's second point is the extension of forest grazing areas. We have already dealt with the restrictions on grazing necessary in the interests of natural regeneration; we will now consider the value of forest grazing in general and its effect on the cattle of India. Forest grazing may be divided into two classes, grazing in natural grass lands such as the *majahs* of Gorakhpur, the low alluvium of North Kheri and other grass plains in the sal forests; and grazing in tree forest such as the sal forests of Oudh and the coniferous forests of the Punjab and Kumaon. The first class is suitable and valuable as a grazing ground and is managed by the Forest department as such, as a reference to any working plan will show. The second class of grazing is worthless or almost worthless. We would welcome a visit by the Agricultural Commission to the grazing areas of Gonda, to the Binga forest in Bahraich, to the deodar forests of the Punjab; except during the rains there is nothing for the cattle to eat. Large areas in Oudh have been ruined as forest and in our opinion their value as grazing grounds is small; they but afford an exercise ground for large herds of worthless cattle who eke out a precarious existence by eating dead leaves and similar worthless food As such cattle produce no milk we are told they are valuable for their manure and our author quotes the statement of the Kumaon Grievances Committee to this effect. We would point out, however, that it seems useless to keep cattle for manure when half their life is spent wandering about a forest; also that the value of manure is dependant upon the diet the animal receives and that consequently the value of the manure of animals grazing in tree forest is very small compared to that of well fed stal cattle. It has rightly been said that the Indian cow is the most expensive animal in the world; free or cheap forest grazing is largely responsible for this The worst cattle in India are found in those localities where cheap grazing is available; for instance compare the cattle of Jhansi, Gonda and Binga with the agricultural cattle of the Doab or the cattle of Kangra with the stock kept in the Punjab plains. There are some beautiful cattle

in Northern India but they are not found grazing in the forest. We have been connected with the management of a large and valuable stud of plough bullocks employed on afforestation work; were these cattle turned out to seek their subsistence by grazing in the forest?; if such a policy had been pursued the financial loss in decreased work done, depreciation, and actual losses by death and disease would have been very great. These animals were well fed and cared for, were able to do their work and lived for many years. One of the greatest obstacles to improved agriculture in India is the poor quality of the Indian plough bullock and to imagine that more free grazing is going to improve his quality is sheer folly.

It is a well established principle of the law of easements that no right of easement can be exercised to the destruction of the property over which the easement exists. The ryot has many destructive habits in various parts of India which are claimed to be necessary for agriculture, but which must be regulated if the forests are to be preserved. The lopping of blue pine for litter in Kulu was stated to be necessary for agriculture; this was not the case as only villages in certain parts of the country and situated near the pine forests were addicted to this habit, their agriculture was in no way superior to other villages who did not lop, and the result of all this lopping was that every pine tree was attacked by the fungus *Trametes pini* and rendered worthless. Again the lopping of oak, which when carried out in a proper way is of great benefit to agriculture, when abused results in the destruction of the forest, and the Kumaon Grievances Committee by removing all control from the class I forests must be held responsible for the ensuing destruction. We cannot expect a very high degree of intelligence in the ryot; his idea is that if he wants to destroy the forest he should be allowed to do so and that whoever prevents him doing so is his enemy. We have a right, however, to expect a higher degree of intellect amongst the political and governing classes. Are they prepared to maintain the balance? in the balance lies prosperity for to-day and to-morrow. If the balance is weighted against the forest, then degradation and destruction is certain;

evidence of the truth of this is on a l sides. Some there are who seek the light and to them we commend the words of "The Illumination", for those who only seek the darkness we have no message.

SOME MISCELLANEOUS NOTES ON BIG TREES IN SIAM.

With the exception of the great rice plain, which lies in the centre and forms, so to speak, the core of the country, the rest of Siam may be described as essentially a forest country. This rice plain may constitute one-seventh or one-eighth of the total land surface of Siam, and since ancient times it has always been more or less thickly populated and intensively cultivated for rice, it therefore contains little tree growth and few forests, but elsewhere, in every portion of the kingdom large areas of forests occur, containing many different types of forest-growth.

The total area of Siam is estimated at 200,000 square miles and the total proportion covered with tree growth or woody growth of some kind or another has sometimes been estimated as high as 80 per cent., but at any rate, it is safe to say that 65 per cent to 75 per cent. is uncultivated, being covered with forests, ruined forests, secondary growth caused by shifting cultivation, grassy plains and swampy lands.

Geographically Siam is bounded on the west by Burma, on the north by the Shan States, on the east by Indo-China and to the south it occupies the greater part of the Malay Peninsula extending down as far south as latitude 6° N.

It is but natural that a country thus situated should possess an extremely rich flora, as it contains so many species found in Burma, the Shan States, Indo-China and Malaya, besides having a considerable native flora of its own not found elsewhere.

It is possible that in some parts of Siam, certain species of trees attain dimensions which are equal to or even greater than any recorded elsewhere. During my stay in Siam I have gathered together some miscellaneous notes from various sources on big

trees and big timber in Siam and I am setting these forth herewith in the hopes that they may perhaps be of some interest. As far as I am aware, no records or observations on this subject have been published in the past.

The first tree to consider is the teak tree which has been and still is the most important economic tree in Siam.

Briefly, it may be stated that teak forests occur scattered about all over northern Siam, intermingled with other types of forest vegetation.

Geographically, nearly all the teak forests are situated between latitudes 17° N. and 20° 30′ N., and between longitudes 97° 30′ and 101° 20′.

Topographically, the whole teak zone of northern Siam may be termed hilly and often mountainous, and the tract is served by six rivers, possessing a vast number of tributaries of all sizes and description.

The greater part of the teak bearing areas lie between the 650′ and 2,500′ contours, and as a rule the teak does not extend much higher than 2,500′ elevation.

Siam has always been well known for its large teak trees and teak timber, and it is probable that the teak tree attains in northern Siam as large dimensions as anywhere in the world, but unhappily, in recent years teak giants are not so easy to find as in the past, but even now there are a certain number of really big Siamese teak trees, as yet untouched.

The following is a description of what is believed to be the largest teak tree now standing in Siam. It was carefully measured on 18th May 1925 by Khun Wilas Wanawitaya a trained Siamese Forest Officer:—

Situation on the banks on the Huey Tam Din, a branch creek of Huey Mehng, which is a right bank tributary of the creek Nam Tron, within the civil sub-division Saan Taw in the Province of Utradit

Measurements.—Girth 29′ 5″ at 4′ 6″ from the ground. Total height to the top of crown 151′

Except for some large holes on either side of the bole at a height of 47′ it would have a perfectly clear bole of 77′.

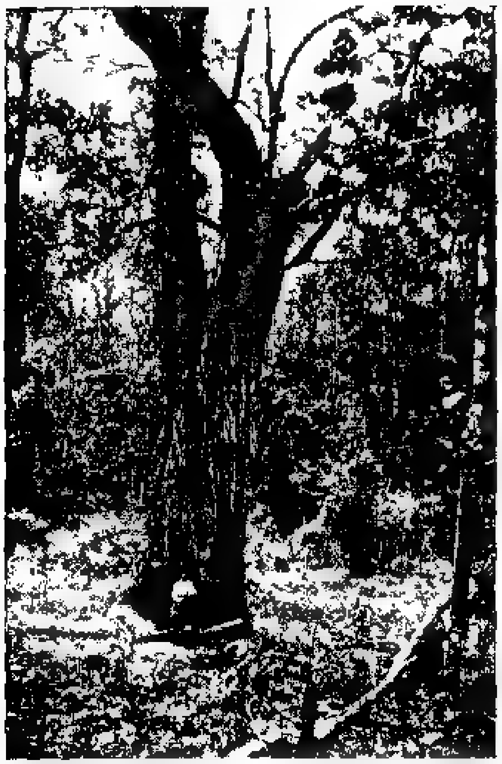
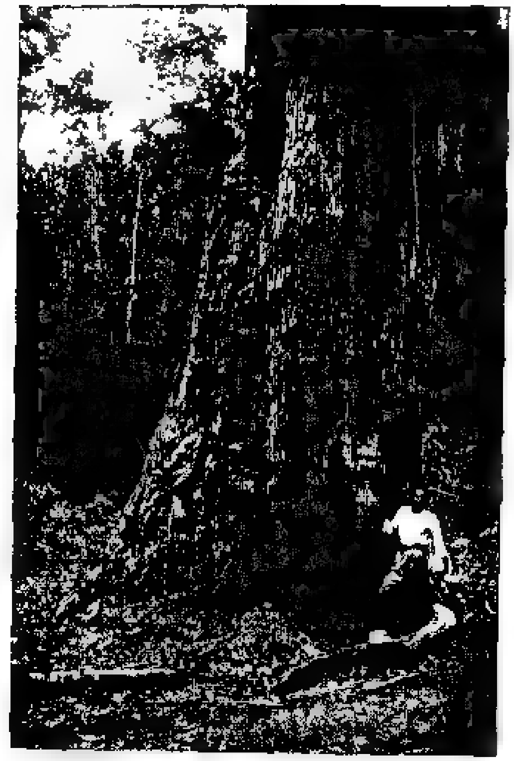


Fig. 2.—Teak (*Tectona grandis*) girth at breast height 27′ 6″. Muang Long Forest, Lampang Forest division, N. Siam.



Photos by Phra Winit Wanandorn, Siamese Forest Service.

Fig. 3.—Teak (*Tectona grandis*) girth at breast height 27 ft. 6 ins. Muang Long Forest, Lampang Forest division, N. Siam.

Fig. 4.—Girdled teak tree 19′ 6″ girth at breast height, standing in the Me Het Departmental Teak Forest, Prae division, Northern Siam.

Photos by D. Bourke Borrowes.

Fig. 5.—Fine large teak log at depot of Messrs The Borneo Company Ltd., Me Fang Forest, N. E. Siam. Total length 39′, mid girth 11′ 4″, *cubic contents 313 c. ft.*

Notes.—The base of the tree is more or less buttressed and also fairly fluted but nothing indicates general unsoundness. The crown is normal and the bole quite straight.

This great tree is growing near 17°30 atitude, that is to say, not far from the southern boundary of the Siamese teak zone.

I have unfortunately not been able to secure a photograph of this tree, but 2 photos are given (Plate 6, figs. 2 and 3) of a large old teak tree measured and photographed by Phra Win't Wanadorn, Divisional Forest Officer in charge of teak girdling division, in the Muang Long forest which is situated in the Lampang Forest division.

This tree has a girth of 27′ 6″ at breast height. As can be noticed in the picture it is over-mature and unsound but is notable for its great size and girth

A photo taken by myself, in the early part of 1925, shows the lower portion of the bole of a fine large teak tree 19′ 6″ in girth at breast height (Plate 6, fig. 4.) This tree was growing in a small side-creek in the Departmental Forest of Me Het in the Prae Forest division. To all external appearances the tree appeared to be perfectly sound; it had recently been girdled.

A certain creek called Nam Heng in the Nan sub-division of the Prae Forest division, situated approximately between latitudes 18° 15′ N. and 18° 30′ N., towards the south-eastern boundary of the Siamese teak zone has always been well-known for the large teak growing on its banks. Phra Winit has kindly forwarded an extract from the girdling statement of the forest lying along this creek. The teak trees were measured and marked for girdling by a girdling party in the 1921-1922 season but have not yet been girdled. From this statement it appears that, in this comparatively small area there are standing no less than 45 teak trees 20′ and over in girth. The smallest of these has a girth of 20′ and the largest is put down as being no less than 28′ 6″ in girth. The average girth of these 45 trees is 22′ 8″. It is also worthy of note that Mr. M. Swete, a Forest Officer of long service and experience

in northern Siam measured and recorded in his diary of 7th August 1909 two teak trees standing in this same creek, one with girth of 26′ 8″ at breast height and the second with a girth of 23′ 5″.

The abundance of large teak trees in the past in northern Siam and their remarkable dimensions is amply attested by all the senior Forest Officers in northern Siam some of whom have served nearly 30 years in those regions. Had systematic measurements of large teak been carried out 20 to 30 years ago it is probable that some striking data would have been collected.

In the records mentioned in Professor Troup's "Silviculture of Indian Trees," Vol. II, pages 698 and 699, I cannot find records of standing teak surpassing these I have quoted. The largest girth recorded is that of a teak tree measured in Travancore with a girth of 26′.

As regards large teak logs, I was recently on tour through portions of north eastern Siam and I was much struck with some of the fine large teak which I saw in this tract of country. It may be mentioned that the teak forests in this part of Siam have been exploited for a much shorter period of time than in any other part of the country, and are consequently almost virgin forests. They were hitherto considered to be inaccessible and it is only in recent years that means have been found to exploit them successfully. This is in great contrast to the teak forests in every other part of the country which have been over worked for many years, in some cases, as records show, as far back as 1880 A.D.

The two local rivers the Me Ing and the Me Kok flow north-eastwards into the great Me Khong river, which, in this locality forms the boundary between Siam and Indo-China, and it is only in the last 15 years or so that teak timber has been extracted down these rivers into the Me Khong, and thence floated down to Saigon; in fact, the credit of this achievement is due to Monsieur Lesterre the present Forest Manager of the French teak firm Est Asiatique Française, who really invented the present system of floating and rafting teak logs down the Me Khong.

In the case of the teak timber growing in the Me Fang valley which is a tributary of the Me Kok, Messrs. the Borneo Company Ltd., for the last few years, have been extracting the teak timber westwards, for long distances, over the high watershed between the Me Khong and Me Ping drainage areas. To accomplish this purpose the Company constructed two sections of tramway and two chutes or dry slides, the larger of which is 1,000 yards long.

Mr. Lingard, forest assistant of the Borneo Company in charge of the Me Fang forests, has kindly given me the measurements of the largest teak log extracted from these forests during the past four years which are as follows, total length 58′6″, mid-girth 9′11″, making the cubic contents by quarter-girth measurements to be 359 cubic feet. I myself saw a fine sound teak log lying in the depôt which I photographed, its measurements were — total length 39′, mid-girth 11′4″; cubic contents by quarter-girth measurements is 313 cubic feet, (Plate 6, fig. 5).

Monsieur Decamps, forest assistant to La Compagnie Est Asiatique Française, kindly supplied me with the measurements of a number of large teak logs extracted during recent years from the Me Ing forests. These are all official measurements taken conjointly by the Forest department and the firm for the purposes of royalty payments. From these I have taken a few of the largest which I give herewith in order of size:—

(*a*) One teak log still lying (A.D. 1926) in Me San a creek near Doi Pakon, 7 or 8 miles distant from the Muang Pan bungalow—total length 62′, mid-girth 10′6″, cubic contents by quarter-girth amount to 427 cubic feet.

(*b*) One teak log extracted from the Me Yen creek, total length 41′1″, mid girth 12′, cubic contents by quarter-girth amount to 369 cubic feet.

(*c*) One teak log extracted from the Me Ong Po creek, total length 64′8″, mid-girth 8′10″, cubic contents by quarter-girth amount to 316 cubic feet.

(*d*) One teak log extracted from the Me Yen creek, total length 49′10″, mid-girth 10′1″, cubic contents by quarter-girth amount to 311 cubic feet.

None of these teak logs, however, can come up to the biggest teak log ever brought out from the forests of Burma, of which a description and photograph were published in the *Indian Forester* of February 1923. It is stated that this log is still lying in Rangoon; its total length is 82'6' and its mid-girth is 10', consequently it contains 515·6 cubic feet of teak timber.

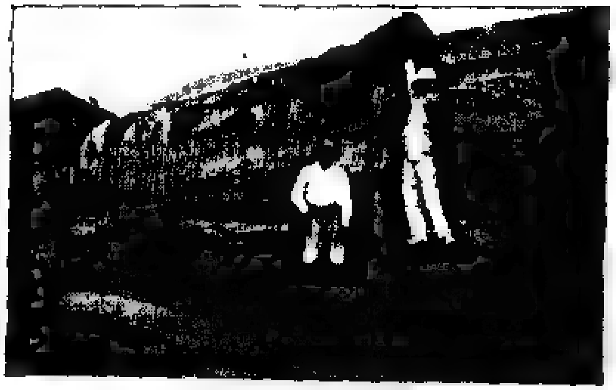
In the following pages an attempt has been made to summarize some of the most striking data, collected in various parts of Siam, about big trees of other species than teak.

There are vast areas of evergreen forests in certain parts of Siam containing many different types of forests. Most of the country covered by evergreen forests is unmapped and often quite unexplored. In such forests the genus Dipterocarpus naturally occupies an important position and attains magnificent proportions. This genus plays an important part in the economic life of the country owing to the importance of its main product wood-oil. In recent years, considerable demands have arisen for the timber of Dipterocarpus both for home consumption and foreign export and also for fuel to supply the Siamese State Railways. The following is the record of a large *gurjan* :—

Dipterocarpus turbinatus.

Measurer.	Locality and situation.	Girth at breast height	Total height	Clear bole	Notes and remarks.
Mr. M. C. Medworth, Inspector of Forests	Near the town of Chiengmai in northern Siam.	22' 4"	70'	50'	Isolated tree, apparently sound

The commonest species of Dipterocarp is *Dipterocarpus alatus*, and perhaps the best illustration of the size which this tree attains in Siam is supplied by two photographs (Plate 7, figs.



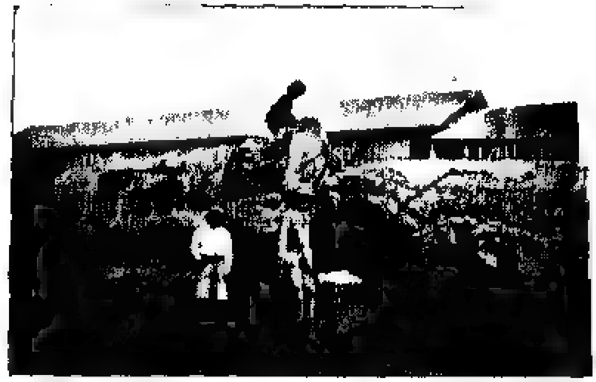


Photo by D. Bourke Borrowes.

Photo by C. Mackintosh

Figs. 6 & 7.—Large log of *Dipterocarpus alatus* in the saw mill yard of the Sriracha Company, S. E. Siam, 20′ long, 18′–8″ mid girth, cubic contents 135 6 c. f.

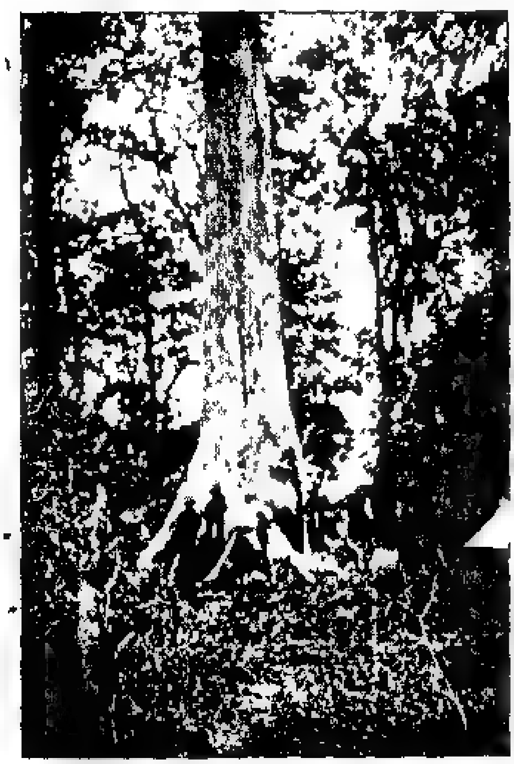


Fig. 8.—*Tetrameles nudiflora* 28′ girth at breast height over the buttresses, 19′ 11″ girth at 11 ft. above the buttresses, 124′ total height, 64′ clear bole.

Photos by Phra Wisit Wanadorn, Siamese Forest Service.

Fig. 9.—*Holoptelea integrifolia* 32′ girth at breast height, 162′ total height.

6 and 7) taken by myself and the Mill Manager in the sawmill yard of the Sriracha Company in south-eastern Siam, in 1924.

This company has been exploiting large forest areas in the south-eastern portions of Siam, that is to say on the eastern coasts of the Gulf of Siam, for the past 12 years or so, using modern American lumbering methods of transport. The company's large American sawmill is situated on the coast at Sriracha, a few hours by steamer from Bangkok.

The manager of the Company has kindly given me the dimensions of this big log as follows—length 20, mid-girth 18' 8", cubic contents 435·6 cubic feet. He also states "We have had two Dipterocarp logs down this year (1926) about the same girth but a bit shorter."

The genus Afzelia is represented in Siam by several species In northern and eastern Siam the common species is *Afzelia xylocarpa* (local name *mai makha* or *mai makha yai*).

I have received two striking records of the great size which this species can attain. The first tree mentioned may be in point of girth the largest in the world. The Divisional Forest Officer, Korat, Phra Anuwat, tells me that it is a famous tree in that part of the world, and that it was the intention of the Lord-Lieutenant to have it accurately measured and photographed for publication in a volume at the Siamese National Exhibition. But, owing to the death of H. M. the late king of Siam the Exhibition was cancelled; as the tree is growing in a very remote part of a range of hills called the Dong Phya Fai, covered with thick evergreen forests, it has not yet been measured by anybody in the Siamese Forest Service, but measurements have been taken by the local head of the village Commune in Siamese measure which have been converted into English measure. The results may, therefore, be taken as approximate.

The second tree, growing in northern Siam, has been measured on two occasions by trained Siamese Forest Officers and their results tally.

Afzelia xylocarpa.

Measurer and date.	Locality and situation	Girth at breast height	Total height.	Clear bole	Notes and remarks.
Mun Aroon in November 1925.	In the Kao E'pom forest, in the civil sub-division Pak-Thong Chai, in the Korat Forest division, eastern Siam.	51' 8	About 60'	About 12'	Still alive and vigorous. Heavily buttressed in five sections
Luang Nithet, D F O and Khun Bonbhal Wanakhet, Asst. D. F O., on 6th May 1926.	On the left bank of Me Yome River in civil sub division Muang Long, in Lampang Forest division, northern Siam	27' 1"	About 110'	About 31'	Forked spreading tree

Another specimen of this tree growing in the Rayong Province of south-eastern Siam measured by Phya Phon on 24th June 1926 had a girth at breast height of 25' 7".

Amongst the evergreen trees of Siam there is no nobler looking tree than *Hopea odorata* which attains splendid proportions and produces one of the best hardwoods in Siam I have received the following information of a large specimen of this tree measured by a trained officer, and the height taken with a hypsometer.

Hopea odorata.

Measurer and date.	Locality and situation	Girth at breast height.	Total height.	Clear bole.	Notes and remarks
Khun Bonbhal Wanakhet in October 1926	Me Peng creek Muang Long forest, Lampang division, northern Siam	34' 4"	210'	70'	Ficus-bound tree.

This species of tree constantly attains girths of 18'—25' at breast height, and I have myself measured trees in various parts of Siam of such dimensions, besides receiving records from several Forest Officers

One of the commonest associates of teak in the mixed deciduous forests of northern Siam is the Burma padauk tree, *Pterocarpus macrocarpus*, locally known as *mai pradoo* or *mai doo*. The valuable timber is much used locally in that part of the country, and in recent years the Chinese merchants have been exporting considerable quantities of logs by rail to Bangkok, whence it is shipped to China for the manufacture of carved furniture and other things. It is now partly taking the place of the well-known Siamese blackwoods or rosewoods which are becoming scarce and expensive.

The following is a record of the largest tree of this species that I have been able to find out :

Pterocarpus macrocarpus.

Measurer and date	Locality and situation	Girth at breast height.	Total height	Clear bole	Remarks.
Khun Boribhal Wanakhet, 9th April 1926	Me Luang creek in Me Pien forest, Lampang division, northern Siam	17' 3"	150'	50'	Tree is sound This forest is noted for the fine padauk trees

The genus Largerstrœmia is widely represented in Siam by several species. In northern Siam there are several species which are common associates of teak in the moister portions of the mixed deciduous forests and the drier portions of the evergreen forests, where the teak tree may be found Owing to their capacity to float in water these trees are being rafted down from northern Siam in annually increasing numbers.

The following are the records of large trees obtained by me up to date :—

Largerstrœmia calyculata.

Measurer and date	Locality and situation.	Girth at breast height.	Total height	Clear bole.	Remarks
D. Bourne-Borrowes in June 1926.	Bungkra forest Pechabun Province, central Siam.	23′ 0	120′	...	Large forked tree
Khun Bor-bhal Wana-kher on 25th June 1926	Me Soong creek in Me Soong forest, Lampang division, northern Siam	21 8	115′	82′	A fine specimen

Largerstrœmia tomentosa.

Measurer and date	Locality and situation	Girth at breast height.	Total height.	Clear bole.	Remarks.
Phra Winit Wanadorn, D F.O., on July 1926.	Nam Wa forest, in Nan Province, Prae division, north eastern Siam.	18′ 3″	130′	75′	In evergreen forest.

Whilst touring with Phra Winit Wanadorn, D F.O., Teak Girdling division in March 1926, we came across two very large trees, growing side by side on rich alluvial soil on the right bank of the Me Yome river. As the first tree *Tetrameles nudiflora* was very much buttressed at the base, girths were taken both at breast height and at 11′ height above the buttresses. This tree was a magnificent specimen with an enormous spread of crown, whereas the second tree *Holoptelea integrifolia*, though larger was not a finely shaped tree. Girths were carefully measured and heights taken with instruments.

Tetrameles nudiflora.

Measurer and date	Locality and situation.	Girth at breast height.	Total height.	Clear bole	Remarks.
D Bourke-Borrowes and Phra Winit Wanadorn, D.F.O., on March 13th, 1926	Supkhang, right bank, Me Yome river, Lampang division, northern Siam	28' 0" girth; at 11' above the buttresses 19' 11" girth.	124'	64'	A magnificent specimen, photo of bole is given in plate 7, fig. 8

I have also received the record of an even larger tree of this species sent in by the Divisional Forest Officer, Suraj division, in the Siamese Peninsula. The girth of this tree at breast height is stated to be 39'. As far as I am aware, this tree was measured by a forest subordinate and not checked as yet by any higher official.

Holoptelea integrifolia.

Measurer and date.	Locality and situation	Girth at breast height	Total height.	Clear bole.	Remarks.
D. Bourke-Borrowes and Phra Winit Wanadorn, D F.O., on March 13th, 1926	Supkhang right bank, Me Yome river Lampang division, northern Siam.	32' 0"	162'	There are two large branches in the main trunk, about 25' from the ground.	Irregularly shaped tree with fluted bole; photo of bole is given in plate 7, fig. 9.

Dr. A. Kerr, M D., Director of the Economic Botanical Survey of Siam has kindly sent me some girth measurements of large trees made by him, during his botanical tours, from which I have extracted the following :—

Cedrela microcarpa, 21' 8" girth at breast height, measured by Dr. Kerr at Che Sawn, Che Hom civil sub-division, Lampang division, northern Siam, on February 1st, 1921.

Hydnocarpus anthelmintica, 15′ 9″ girth at breast height, measured by Dr. Kerr at Na Yom, on the Menam Prasak river in the Petchaburi Province, Central Siam, on March 3rd, 1922. I myself measured a tree of this species on this river in July 1926 with a slightly smaller girth. This is the tree whose seeds produce an oil, with curative properties not inferior to *chaulmugra* oil, so I am informed by Dr. McKane, Superintendent of the Leper Asylum in Chiengmai. It abounds along certain rivers in central and eastern Siam and I really believe if the entire crop of seed were gathered that enough oil could be produced to treat all the lepers in the world. Besides this tree *Taraktogenos Kurzii* has recently been discovered by Mr. H. B. Garrett occurring in northern-eastern Siam.

Pinus Merkusii, 11′ 2″ girth at breast height, measured by Dr. Kerr at Muang Hawt, in Chiengmai division, northern Siam, on July 4th 1922. The largest pine of this species recorded in Professor Troup's "Silviculture of Indian trees," Volume III (page 1093) is that measured by Mr. M. H. Ferrars on the hills between the Sittang and Salween rivers, with a girth of 9′ 7″.

The only other species of pine found in Siam is *Pinus Khasya*. I have received a record of girth for this pine of 15′ 0″, measured by a Burmese Ranger Maung San Ohn in the Me Prick forest, Muang Tern sub-division of the Lampang division, northern Siam, on 2nd July 1925. It is stated that this tree is growing on a plateau 2,000′—3,000′ in altitude. This girth measurement far exceeds that recorded by Mr. M. H. Ferrars, of 10′ 4″, mentioned in Troup's book, Volume III page 1084.

Turning to the part of Siam situated in the Malay Peninsula, one of the finest as well as most interesting and valuable trees in the evergreen forests of that region is *Balanocarpus* spp. which produces not only a first-class hardwood *chengal*, which is the standard local hardwood in the Federated Malay States, but also very valuable gum, known as gum dammar penak. The tree grows freely in the most southern Province of Siam, Pattani, and attains fine proportions.

I send the following record of a fine tree measured by the Divisional Forest Officer. The tree was being felled at the time and most of it was measured lying on the ground. The photograph of the stump which appears to be about 15' high, plate 5 (frontispiece) must draw attention to the wasteful practices unfortunately so prevalent in Siamese forests, especially as the Divisional Forest Officer states that the tree has never been tapped for gum and that the entire bole is sound and solid.

Balanocarpus spp.

Measurer and date.	Locality and situation.	Girth at 7' 3" from the ground	Total height.	Clear bole	Remarks
Luang Abhipal Prasson, D.F.O., on 11th October 1925.	South-west of Bukit Railway Station, Patani division	17' 0"	180'	66'	Sound and not tapped for gum.

Referring to large trees growing in the Siamese Peninsula I must just mention the grove of very large Casuarina trees growing on the foreshore at Singora described by me in the *Indian Forester* of June 1925. The girths of some of these trees, taken over the buttresses exceed 22', and I can hardly believe that larger Casuarina trees than these exist anywhere in the world. If there are such, I should like to hear about them.

Last, but not least, in common with other Oriental countries Siam possesses its great banyan tree, growing near the well-known ruins of an ancient city, called Pimai in eastern Siam. I have not visited this place but from information received it appears that the tree covers about three-quarters of an acre of ground.

D. BOURKE-BORROWES,
Late Adviser,
Royal Forest Department, Siam.

FIRES AND FIRE PROTECTION IN CHIR (*PINUS LONGIFOLIA*) FORESTS

Mr. Greswell, Deputy Conservator of Forests, Hazara, published in the October 1926 number of the *Indian Forester* a very interesting article entitled "The constructive properties of fire in *chir* forests" He points out that in the Siran range of the Hazara district, where the underlying rock is gneiss and early height growth is rapid, the *chir* forests are densely stocked with trees of all age classes in spite of the fact that fires have occurred at short intervals throughout their history. He is of the opinion that the existing crop has grown entirely from "coppice" shoots put out by the young *chir* plants after they have been burnt back by fire. His conclusions are as follows :—

"After, however, some nine years' acquaintance with two very different types of *chir* forests, *viz.*, those of Rawalpindi and Hazara, I would like to hazard the opinion that fire is not an original destructive agency except possibly on steep slopes, and even then here it is only destructive in that it delays etablishment of the young crop. The primary destructive agencies are the axe, grass cutting and any incorrect management leading to conditions in which fire can assert itself as an evil., *e g.*, closure to grazing with the resulting accumulation of inflammable material."

He advocates the burning of *chir* regeneration areas in the winter before every seed year and relies on "coppice" shoots to restock the areas burnt. Conditions in Rawalpindi are very different from those in Hazara, as the forests often grow on thin soil above sheet rock and rock outcrops where growth is poor, and in many forests it is certain that the prophylactic medicine advocated by Mr. Greswell would be almost as bad as the disease itself.

The resistance of *chir* seedlings to fire is very different on deep soil on cool aspects and on thin soil on hot southerly and westerly slopes · on cool aspects young seedlings which have only recently developed a secondary characteristic of thickened bark often survive the effects of a slow winter fire and frequently

Fig. 1.—*Chir* poles killed by fire in 1921. In Utrinna forest.

Fig. 2.—Branched mature *chir* trees in Sang reserve. The forest is very open due to repeated fires. The saplings which have escaped the fires of 1926 are now so widely spaced that they will in their turn develop into branchy trees.

coppice even when burnt to ground level, but on hot exposed aspects they are usually killed outright and fail to produce coppice shoots.

Troup in his *Pinus longifolia*, Indian Forest Memoirs, 1916, is very emphatic on the harmful effect of fire on young *chir* seedlings and attributes twisted fibre to a large extent to damage by fire in earliest youth. In the Rawalpindi forests patches of poor soil and exposed aspects are frequently met with and conditions appear to be more unfavourable than in Hazara. Reliance will not be placed on "coppice" shoots to regenerate *chir* woods and it seems certain that it is necessary to prevent fires in regeneration areas until the young saplings have acquired a thick protective bark to enable them to withstand the effects of a slow winter fire.

As regards the Rawalpindi forests Mr. Greswell's recommendations cannot be accepted in their entirety, the departmental burning of *chir* pole forests has been routine procedure for over a decade, and if the remedy were as simple as Mr. Greswell suggests it would have been adopted years ago. It is clearly recognised that young woods must be burnt departmentally in the winter as soon as is possible without undue risk, in order to save them from destructive summer fires, but Mr. Greswell's suggested remedy of fires in earliest youth and regeneration by coppice shoots would be too drastic, and controlled fires are permissible only when the young saplings have acquired fire resisting properties not possessed by them in earliest youth.

Mr. Greswell will probably remember an article quoted in the *Indian Forester* of 1913 in which Dr. Harper long ago suggested that fire was *necessary* for the perpetuation of the long leaf pine forests of the Southern States, giving as his reasons that fire did very little damage to the saplings "after they reach an age of four or five years." Conditions in the long leaf pine forests of America appear to be similar to those of our *chir* forests, but there again protection from fire during early youth is essential.

We have unfortunately many examples of the harm done by fires to *chir* forests and the illustration Plate 8 fig. 1, shows the extent of the damage which sometimes occurs On the other hand

we have examples of the great improvement of tree growth which has taken place mainly due to fire protection. There are trees still standing in our lower forests which had grown up when the forests were subject to every kind of abuse and when fires ranged unrestrained: the old trees are often stunted, malformed and frequently of twisted fibre, whereas the young trees which surround them already overtop them in height, thus bearing witness to the improvement in the quality of the locality where protection from fire has enabled the young seedlings to survive. The photograph, Plate 9, fig 3, shows a surviver of the old crop in the Beor Khalol reserved forest.

It may be of interest to examine cursorily the history of fire protection in Rawalpindi, the effect of fires on the forests, and the methods now being adopted to combat the ever present menace of forest fires.

The forests of the Rawalpindi East and West divisions lie on the lower slopes of the outer Himalayas, and are situated on Tertiary sandstones and arenaceous clays; the summer heat is intense and prolonged periods of drought aggravate the conditions favourable to the increase in intensity of fires, and once a forest is well alight the efforts of an experienced forest staff assisted by numerous villagers are powerless to check the conflagration.

The history of the Rawalpindi forest fires previous to 1912 is given in an article by the writer entitled "Departmental firing in *chir* forests" published in the *Indian Forester* of December 1913: briefly, recurrent periods of incendiarism culminated in 1911 and 1912 in extensive fires, lit generally by the local inhabitants, whereby most of the valuable forests were burnt. The underlying reasons for incendiarism were then, and still are, the improvement of the grass and grazing, enmity between villages, and retaliation against punitive action taken by Government. The people of the district are conspicuous for their boldness and bravery and form the backbone of many of the best Punjabi regiments, and a man who bears a grudge against the Forest department cares little for the restraining influence of the subordinate forest staff. Apart from malice prepense some of the fires are started accidentally or from pure mischief and the desire to see a good blaze; they

are generally started at night when there is little fear of detection and the incendiary can easily make good his escape. Fire lines, firewatchers, special night patrols, etc., have all been tried in vain, and it has been found that once the villagers have made up their minds to burn the forests nothing the forest staff can do will prevent them. As will be noted later on the relations between the villagers and the department have improved, but a recrudescence of incendiarism in 1926 has shown that there is always the chance of past conditions again prevailing.

I well remember my first experience of a forest fire soon after I had taken over charge of the Rawalpindi division in the hot weather of 1912. I was in camp at the Narar forest bungalow which stands on a hill and forms a convenient observation point from which large stretches of forest are visible on all sides in the valleys below. One evening fire broke out in the Panjar block, and as I marched rapidly down hill I saw fires start in no less than eleven different places. The Ranger and his staff got to the forest immediately and soon were busily engaged in extinguishing the fires, nominally assisted by numerous villagers, some of whom helped to extinguish the fires and some of whom restarted the fires in fresh places, and as soon as one fire was brought under control another commenced in a totally different part of the forest. It was quite impossible to catch the culprits at night and by morning over 2,000 acres of dense *chir* woods had been burnt. An epidemic of fires spread all over the division and it was a common experience to see several fires burning simultaneously on different hillsides.

Notwithstanding these fires the *chir* trees showed a marvellous power of recovery, which was due to the thick bark developed by the *chir* tree at an early age. The regeneration below a height of five to eight feet had almost invariably been destroyed but poles and mature trees had generally escaped with their bark and branches severely scorched, in places the trees were killed outright and occasionally the damage was very great indeed.

In the winters of 1912 and 1913 numerous experiments were made by the writer and a system of firing during the winter all woods not under regeneration was evolved and was incorporated

in the revised working plan (Murree-Kahuta 1915, by M. R. K. Jerram, Deputy Conservator of Forests). Details of the methods employed are quoted in Troup's *Pinus longifolia*, Indian Forest Memoirs, 1916. It was known in 1913 that in favourable circumstances, and if great care were exercised sapling woods could be burnt in winter without undue damage, but as departmental burning was then in its infancy it was thought better to confine burning to pole woods and not to prejudice the success of the scheme by applying it to regeneration areas in which the margin of safety was very low indeed. The revised working plan accordingly prescribed the winter burning of all woods not under regeneration with strict protection from fire of P.B.I.

The new policy was successful for more than a decade, and as a consequence Government was able in 1916 to concede to the villagers the right to cut grass, to graze cattle and to collect firewood in the reserved forests in return for good behaviour and for help in fire protection. The announcement coming directly after the fall of Kut and the capture of hundreds of soldiers recruited in the Rawalpindi district, when the spirits of the people were at a low ebb, caused a good impression and a marked improvement in the relations between them and the forest department. In 1921, the year in which hundreds and thousands of acres of coniferous forests were burnt throughout the Himalayas the forests of the Rawalpindi East and West divisions escaped with only a very small acreage burnt, and by 1922 the forest staff prided itself on its capacity to extinguish any fire and to protect regeneration areas giving rise to an entirely false sense of security.

The year 1926 proved a rude awakening when several thousand acres of forest were burnt, including over 1,000 acres of dense regeneration in P.B.I. The reports of the fires remind one of those of fifteen years ago, except that much greater help was obtained from the villagers ; despite the efforts of the forest staff, which had been greatly strengthened, the fire spread over large areas and were only extinguished finally by the monsoon rains, by which time the staff had been out night after night in continuous efforts to save the more valuable woods. That their efforts did meet with a large measure of success is very much to their credit

and to that of the majority of the villagers who loyally helped to extinguish fires.

The effects of the 1926 fires have been various. In pole woods which have been burnt departmentally little damage has been done, except that the wounds caused by unhealed resin channels have been extended; in two forests where winter burning had for special reasons been omitted the trees have suffered severely and many have died owing to fierce fires intensified by an undue accumulation of fallen needles and by the presence of unconverted timber, the refuse of past fellings. In woods under regeneration the damage has been very great indeed. On northern and eastern slopes homogeneous groups of saplings of fair extent have survived here and there throughout the regeneration areas: between these groups single survivors occur at wide intervals, the remainder having been killed outright. It may be expected that by the time fresh seedlings are established the isolated advance growth will develop strong side branches, and that if left alone these woods will develop in due course into irregular woods similar to the present forests with all ages and sizes represented. On southern and hot exposed aspects, where the soil is generally thin, the burning has invariably been more severe and saplings survive either singly or in very small groups, which normally will develop into branchy individuals exactly similar to those of the existing woods. It is interesting to note how like conditions produce like results and how type begets type which persists in succeeding generations. Plate 8, figure 2, shows trees in the Sang Reserve, which area is known to have been burnt at frequent intervals throughout its history, and illustrates the best type of timber produced on soil of high quality on hot aspects; it will be observed that the branches have persisted to such an extent as to render the timber knotty and comparatively valueless.

The problem of the pole woods offers no difficulty except in forests tapped for resin where the resin channels catch fire unless the bases of tapped trees are carefully cleared of needles: the scheme for winter burning will be extended and so revised as to allow of all forests not under regeneration being burnt at least once in every two years; compartments will be divided into two

halves which will be burnt in alternate years thus facilitating the production of grass and the provision of grazing for the villagers' cattle.

The woods under regeneration in P.B.I. present an entirely different and a more complicated problem, and it is by no means easy to evolve a correct policy for their treatment owing to the varying conditions encountered.

When the working plan was prepared in 1914 the stock was very unevenly distributed. Mature trees sometimes occurred in groups but more often were scattered irregularly throughout the forests. P.B I. accordingly contained patches of poles, commercially unripe for felling, in addition to typical mature woods and advance growth. In mature woods the first seeding fellings were light, but later on their intensity was increased so as to allow of the retention of only 4 to 8 seedbearers per acre : there was some advance growth on the ground, and as seed years occurred every three or four years numerous fresh seedlings appeared, and by 1926 most of the areas felled over were fully stocked. The treatment of the pole woods included in P.B.I has varied : previous to 1921 in the West division and 1922 in the East division they were allowed to form part of the future crop, but in late years they have been felled over in regeneration fellings with lamentable results and the regeneration of such areas will not be easy quite apart from the great sacrifice of material involved by the felling of immature trees. In 1922 the working plan was partially revised so as to concentrate the regeneration fellings over hundreds of acres of forest in one ring fence. The danger of fire was discounted owing to the apparent immunity from incendiarism and a definite attempt was made to force the forests into almost complete uniformity over extensive areas : it is needless to say that this policy has been abandoned since the fires of 1926 have demonstrated its impracticability and the working plan is now being revised.

Since 1916 the fellings and conversion have been done departmentally, at first primarily to meet War indents. Difficulties of transport were enormous as the greater part of the output is carried by camels of which there is a limited supply, and during

Fig 3.—Mother tree typical of old crop with well grown *chir* poles showing improvement in factors of locality in Beer Khalo reserved forest.

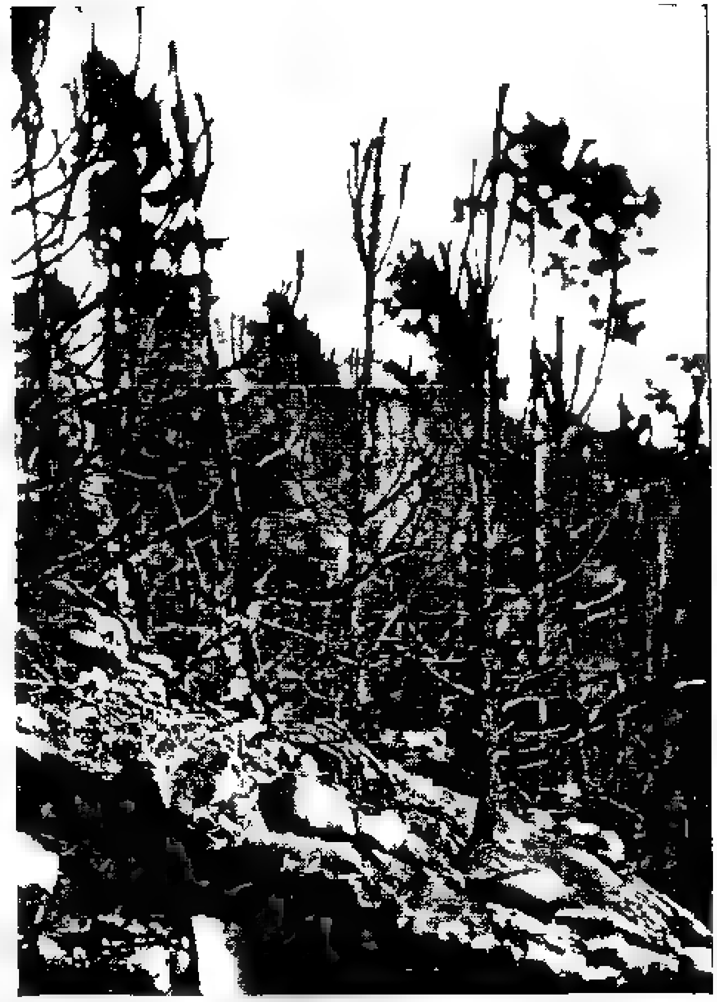


Fig 4.- Saplings killed by fire in 1926 in Kaoran Chalala forest. Note the way in which rain is eroding the soil.

the war only the best timber was converted, and the tops of the trees and knotty timber were left in the forests. The regeneration areas are now littered with rubbish and although spasmodic attempts have been made to get rid of the slash by burning the removal has nowhere been complete and the dead timber and slash are everywhere present throughout the young growth. In May and June 1926, more than 1,000 acres of regenerated woods were burnt, and where slash was present destruction of young growth has been complete. The damage has been greatest on southerly hot aspects where most of the saplings have died. A very few of the saplings have given rise to "coppice" shoots, but the stocking is now so incomplete that only branchy trees will be produced, unless the regeneration areas are cut over so as to allow of the removal of branched saplings when a fresh crop of seedlings appears on the ground. Fortunately sufficient seedbearers have been left, which, it is hoped, will restock the areas. Plate 9, figure 4 shows the Kaloian Chalula forest where 80 per cent of the regeneration was destroyed by fire in the hot weather of 1926.

The conclusion has now been accepted that it is impossible to protect absolutely regeneration areas from accidental or incendiary fires, and experiments are being made to ascertain how soon it may be possible to burn regeneration areas departmentally during the winter in order to minimise the damage which results from fires in the hot weather.

Much experience of the response of young seedlings and saplings to fire has been gained during the last few years. In some woods not allotted to P.B.I. parts of the forests contain flourishing patches of saplings through which winter fires have passed when the woods have been burnt departmentally. Experiments have been made by Mr. Gorrie in the West Rawalpindi division in 1924-25 and by Messrs. Holland and Pring and by the writer during the current winter. It has been proved that once the saplings have reached a height of seven or eight feet they suffer to a negligible extent from the effects of a slow winter fire, saplings of five or even three feet in height generally survive, but the cambium is often damaged. Seedlings which have not

developed secondary characteristics of thick fire resisting bark and rapid height growth are generally destroyed even by the slowest fire. Light cattle grazing is advantageous and reduces the intensity of the fire: grass cutting also assists in fire protection but as the grass cutters habitually cut young seedlings along with the grass it is necessary to exclude them from crops in which the seedlings are not fully established; the thinning out of young saplings gives improved results but it is doubtful if the cost and the difficulty of getting rid of the refuse will not render this operation prohibitive when large areas have to be dealt with: the refuse from fellings made at least 10 or 12 years previously burns fiercely and kills saplings outright.

These experiments have been carried out under strict supervision, and unfortunately it has been difficult to find areas in which no felling debris was present, which invariably vitiates results. During the winter of 1925-26 about 100 acres of young regeneration on a steep hill side of northerly aspect in Panjar compartment 57 were burnt departmentally owing to a mistake of the range officer. The damage done to the young crop was far greater than in any area fired under strict supervision this year: many of the young saplings and seedlings were killed, though some on good soil on cool aspects have thrown out coppice shoots. The damage has been too great to allow of an operation of this nature being prescribed as a routine operation in young crops, and it proves that it is necessary to allow a margin of safety for carelessness in supervision and execution, and the writer considers that it would be dangerous to prescribe the general burning of sapling woods of less than seven or eight feet in height, at any rate until more experience of operations over extensive areas has been gained. It has been remarked that in a regeneration area, seedlings appear every three or four years, and that the area is not usually fully stocked after one seed year; it is thought that it is desirable not to commence burning until the majority of the saplings are about seven feet in height, which means that it will be necessary to protect areas from fire for some years after the first fellings have taken place.

The age at which the saplings reach a height of seven feet varies greatly according to the amount of light they receive, the quality and depth of the soil, and the treatment to which the felling area has been subjected. The Sangseri forest was full of felling debris which an accidental fire burnt completely in 1921, but already the seedlings have attained a maximum height growth of 6′ 10″ and an average height of about 3′ 6″, a good example of the benefit which may be expected to accrue if debris is always burnt after the first seeding felling. Under ordinary conditions seedlings grow very slowly for the first few years and it is probable that complete protection from fire will be necessary for at least ten to fifteen years after the seeding fellings when controlled fires may be started in regeneration areas. Experience alone can prove if it is possible to commence burning at an earlier age and the experiments are being continued.

The following suggestions are submitted for the correct management of regeneration areas in the *chir* forests of the Rawalpindi divisions :—

1. The first seeding felling must be so heavy as to render it possible to remove the greater part of the standing crop in one operation. Four to six mature seedbearers per acre are ordinarily sufficient on cool northern and eastern slopes : on hot aspects eight to ten seedbearers are required to sow up the area felled over.

2. The slash, the tops of the trees and refuse timber must invariably be burnt, preferably in the winter before a seed year of which ample indication is furnished as the cones take over two years to develop. The burning of refuse is an obligatory operation after the first seeding felling even if it involves the sacrifice of advance growth, which will soon be replaced by young seedlings as sufficient seedbearers are left to restock the area

3. The seedbearers must be allowed to stand until after the first controlled winter fire has passed through the young crop.

4. Regeneration areas must not be concentrated unduly.

5. A certain amount of irregularity in a young wood should not be looked upon as a disadvantage and complete uniformity should not be attempted : in particular patches of poles should

be left to form part of the future crop when even of only moderate extent as they have reached a size at which they are ordinarily safe from fire.

The regeneration areas must be rigidly protected from fire for the first few years after felling until the majority of the saplings have reached a height of about seven feet. Grass cutting and grazing should be encouraged in order to reduce the amount of inflammable material. If practicable and not of prohibitive expense the young saplings should be thinned out and the refuse burnt.

7. Once the young woods have reached the height of about seven feet they should be burnt departmentally after rain in the winter by a fire which is constrained to burn only down hill.

CAMP LEHTRAR: H. M. GLOVER, I. F. S.,
23rd February, 1926. *Deputy Conservator of Forests, Punjab.*

NOTE BY MR. N. G. PRING, I. F. S., RAWALPINDI :—

Mr. Glover in his article entitled " Fire and Fire Protection in *Chir* (*Pinus longifolia*) Forests " puts his case very clearly and submits some valuable suggestions among which he points out that the regeneration areas must be rigidly protected from fire for the first few years after felling until the majority of the saplings have reached an age of about seven feet.

He also states that a height of seven or eight feet corresponds to an age of ten to fifteen years. In view of the recent history of the Rawalpindi *chil* forests it can hardly be expected that fire will never reach regeneration areas, though grazing, grass cutting and tending may go far to reduce the number and intensity, and the writer would like to submit the following suggestions which could easily be applied in addition to Mr. Glover's.

1. The departmental firing of all pole crops in regeneration areas.

2. The departmental firing of a strip immediately below and above roads or inspection paths passing through regeneration areas.

3. The departmental firing of a certain number of strips connecting roads and pole crops, etc., with the idea possibly of isolating a fire and certainly of delaying it till a sufficient staff have assembled to combat it.

As regards burning departmentally areas under seven feet in height, provided (1) grass is cut below the saplings, (2) the area is burned down hill and (3) the greatest care is taken, the writer is also confident that regeneration areas of only three feet height can be burned with a small percentage of loss but that not more than two acres can be burned under strict supervision in an eight hour day.

The operation is, therefore, prohibitive on a large scale, but a thirty foot strip below a road and a twelve foot strip above a road can be departmentally fired a distance of one-third mile in one day.

This operation will allow the staff to concentrate on the road with safety during a fire even if it does not prevent a fire crossing it, losses caused by departmental firing until the remainder of the crop has reached a height of seven feet can be replaced by artificial methods most easily along a road.

The writer noticed that fires which occurred last year jumped six foot camel roads in compartments 23, 24 and 59 (where departmental burning had not been carried out) of the Rawalpindi East division.

The writer also noticed that the few groups of saplings saved in compartments 23 and 24 lay above or besides patches of stony ground or land slips, where, when the fire was not actually diverted, its intensity was obviously reduced. Similar conditions as well as patches of advance growth should, therefore, be taken advantage of when departmentally burning strips to connect firelines, roads and pole crops.

Finally it is suggested that in large P. B. I. areas, strips of overwood both along the contours and across the contours should be left unopened and burned annually until the regeneration has reached an average height of seven feet. The first seeding felling in these strips would coincide with the second felling of the main area.

Experimental markings on the above plan were made by the writer in 1923, but unfortunately they had to be abandoned, as it was decided owing to an undue concentration of regeneration area in the neighbourhood, to transfer the compartments in which they were made from P. B. I. to P. B. II.

REFINING OF CRUDE KATHA.

A sample of crude Katha was received from Shahjehanpur in the form of dark coloured round balls It was stated that this Katha was not finding a ready sale and an enquiry was made whether it would not be commercially possible to get out of it good quality Katha, which could be sold in the market.

The chief constituents of Katha are (1) catechin, which is valued for masticatory purposes and (2) catechu-tannic acid, which may be looked upon as an adulterant lowering the quality of Katha to be used as a masticatory, and which is of value only for dyeing purposes (as in Cutch).

The problem, therefore, reduces itself to one of finding out a cheap and convenient way of getting rid of as much of the catechu-tannic acid as possible and getting a product rich in catechin.

Cold water dissolves catechu-tannic acid rather freely whereas its solvent action upon catechin is of a very low order. An attempt was made to separate Katha (crude catechin) from the Shahjehanpur sample by simple treatment with water. One kilogram of the powdered sample was allowed to soak in three litres of cold water for two days. By this procedure most of the catechu-tannic acid passed into solution leaving the bulk of the catechin undissolved. The resultant mixture was cautiously decanted through a piece of jean cloth, on which the Katha (crude catechin) formed a layer, and the solution of catechu-tannic acid passed through In decanting care was taken not to transfer to the filter the residue of sand, etc., which had settled at the bottom of the vessel in which the soaking had taken place. The layer of Katha in the filter was washed on the filter twice with

cold water (500 c. c. each time), after which the stuff was collected and pressed in a screw press to get rid of the adhering solution of catechu-tannic acid as far as possible.* It was then dried by exposure to the sun and weighed. The filtrate containing catechu-tannic acid was evaporated down to get Cutch. The amounts of moisture contained in the Katha and the Cutch thus produced were then accurately determined. The following result was obtained :—

Yield of "dry" Katha	..	34·5 %
Yield of "dry" Cutch	..	53·5 %
		88·0 %

The difference of 12 per cent. is to be attributed to the moisture and insoluble mineral impurities originally present and to losses inevitably involved in working the process. In this connection reference may be made to the great ease with which catechin is transformed into catechu-tannic acid and the inhibiting action of the latter substance on the crystallisation of catechin.

It may be noted that the Katha obtained was a much better product and contained 57 per cent. catechin as compared with the original sample which contained only 33 per cent.

A second experiment was carried out to see the effect of recrystallising the product (crude catechin) left undissolved on treatment with water

A fresh amount of one kilogram powdered sample was treated in exactly the same way as in the first experiment as to soaking, filtration, washing and pressing in the screw press. The crude catechin thus obtained was then redissolved in two litres hot water and the resulting solution was allowed to cool and stand for four days. The crop of crystals obtained was filtered off and, after being washed with 500 c.c. cold water, was put in the screw press and then dried in the sun. It was then analysed for its moisture and catechin contents.

* In some subsequent experiments the operations of filtering and washing were effected with the help of a filter press. As is to be expected the work was more efficiently and conveniently done by this means.

The yield of recrystallised Katha amounted to 22 per cent. (calculated dry) of the original sample. The catechin content of this recrystallised Katha was 68 per cent.

It will thus be seen that it is possible to separate a good quality Katha (and at the same time get Cutch) out of the Shahjehanpur sample by very simple methods of procedure. Soaking and washing with cold water alone gives a product containing 57 per cent. catechin, while an additional process of recrystallisation gives a Katha containing 68 per cent. catechin. In the second process a loss in yield, however, takes place. This is not to be wondered at as the treatment involves a degradation of some catechin into catechu-tannic acid.

Which of the above two processes is to be adopted in actual practice depends on the possibility of the purer product commanding a higher price which would thus compensate for the additional cost of working and the loss involved.

Personally the writer doubts whether this would be the case and he thinks the simple process of removing the catechu tannic acid with the help of cold water alone would be sufficient.

J. SEN,
Biochemist,
Forest Research Institute.

SEED OF OCTOMELES SUMATRANA.

Mr. C. E. Lane Poole, The Forestry Adviser to the Commonwealth Government of Australia, has a small quantity of seed of *ilimo* (*Octomeles sumatrana*) for free distribution. The following excerpts regarding this species have been culled from his report on the Forests of New Guinea :—

DATISCACEAE.

Octomeles sumatrana Miq., Nos. 34, 589.

Probably the largest tree of Papua; 15 feet girth; 100 feet bole and 180 feet over all. Heavily buttressed; buttresses spread out 8 feet and ascend to a height of 12 or 15 feet.

Leaves.—Simple, alternate, petiole up to 12 inches long in young trees and blade 12 × 9. In older trees petiole 2½ to

5 inches grooved; blade 5 to 9 by $2\frac{1}{2}$ to 7; cordate, acuminate, glaucous; midrib and base of veins red-brown.

Flowers.—Pendant spikes 12 to 18 inches long of sessile flowers. Only specimens seen were picked up off the ground and appeared to consist of unfertilised flowers.

Fruit. -Not seen.

Heartwood.—Rays conspicuous; 100; dark brown; sinuous round pores 1/40 inch deep; show on quarter as specks and wavy lines. Pores—Conspicuous, 1,500 to 3,500 in more or less porous zones; single and radially septate (2). Soft tissue—Absent. General—A light brown straight grained porous wood. Solution wood; slightly discoloured; no precipitate Cuts very soft and clean. 23 lb. per cubic foot. Sapwood.—Same as heart, but the colour is light yellow, and it weighs 21 lb. per cubic foot. Also the wood is softer and more woolly to cut.

Bark.—Grey brown, scaly, 1 inch thick. Inner bark red-brown. Somewhat ridged at butt.

Locality. -Well distributed throughout the lower altitudes and alluvial flats all round the coast. Attains largest dimensions on alluvium bordering large deep rivers like the Vanapa, but is also to be found growing to a great size in pockets of the foot-hills up to 1,500 feet.

Locality.—Vanapa, Veimauri, Aroa, Kumusi and all rivers of Buna District and of foothills of Hydrographer Range.

Date.—Fruit ripening in September, 1922.

Native names. -Ipa (Evara), Kakerim (Yabim), Usu (Yaiu), Erima (Rabaul), Ilimo (Motu and Suku), Benumba (Buna, Binendeli, etc.), I—Ohea (Vailala).

Remarks —A fine wood, suitable for all kinds of indoor carpentering work. It has a pretty satin grain, and is very light indeed.

Material collected.—Leaves and spikes of dry flower calyxes wood, bark.

There is another type of forest along the banks of most large rivers in the Territory which consists principally of *ilimo* (*Octomeles sumatarana*), a magnificent tree which yields a timber

which has much to recommend it for all indoor work. It reaches a height of 180 feet and sometimes 200 feet in favourable localities, and has a girth above the buttresses of about 15 feet. The buttresses are heavy and spread out 8 feet from the bole, and rise to 10 or 15 feet up it The bole is generally clear and straight for 100 feet It is found in two formations:—(i) scattered singly or in groups of two or three in the damper places along the river and creek banks of the rain forests, (ii) in dense formation along the banks of large waterways. It is the second formation that I am about to describe, as it differs very much from any other in the Territory

Ilimo is a social species, and anywhere that a large river such as the Vanapa or the Brown has deposited a mass of alluvium and made new ground, it comes up in a dense mass All who have travelled up the large rivers of the Territory will have noticed these patches of young trees They are most conspicuous, not only because with them is associated no other species, but because they are of even age, they have all grown up together. The young *ilimo* is a remarkably attractive tree with its symmetrical arrangement of branches, its large green, heart-shaped, drooping leaves, and its freedom from creepers and epiphytes, so that one instinctively remarks on the healthy appearance of the clump one passes.

Here are the figures relating to an 8-acre patch of over-mature *ilimo* on the Vanapa. It is sufficiently aged for the intruding species to be for the most part mature. It will be seen that there are only ten species and that there are 62 individuals in all, of which there are 39 *ilimo*, or 64 per cent of the stocking, and these cubed 14,130 feet. The largest girth was 15 feet, and the highest clear bole 120 feet. It is very unfortunate that these heavy stands of *ilimo* are not more numerous, for there is no doubt that the timber is sufficiently useful to command a good price, the extraction offers no difficulty, its transport down stream is simple, and it mills very well indeed. I have not, however, found any but small patches of such forests in the parts of the Territory I have visited.

Description of timber on an area of 8 acres—Vanapa.

Herbarium Number.	Native Name.	Botanical Name.	Number of individuals.	Cubic Contents. Total.	Per Acre.	Per Tree.	Percentages of— To total cubic contents.	To total number of trees.
							%	%
1	*Damont* ..	*Dracontomelum mangiferum*	6	526	66	88	3·1	9·7
2	*Kaeda* ...	*Planchonia timorensis.*	1	128	16	64	0·75	1·6
4	*Nara* ...	*Pterocarpus indicus.*	2	403	50	201	2·4	3·3
5	*Okamu* ..	*Pometia pinnata*	1	205	15	205	1·2	1·6
13	*Siku* .	*Pterocymbium sp.*	1	259	32	259	1·5	1·6
20	*Uri* ..	*Garuga sp* ...	4	610	76	152	3·6	6·4
34	*Ilimo* ..	*Octomeles sumatrana*	39	14,130	1 766	362	82·7	62·9
36	*Okaka* ..	*Terminalia catappoides*	1	118	15	118	0·7	1·6
51	*Habere* ...	*Dracontomelum sp.*	6	456	57	76	2·7	9·7
106	*Atutablakuna.*	*Indt.* ..	1	242	30	242	1·4	1·6
			62	17,077	2,254	565	100·0	100·0

Applications for seed should be addressed to Commonwealth Forestry Adviser, Home and Territories Department, 61, Spring Street, Melbourne, Australia.

A FAITHFUL SPOUSE.

During the course of my cold weather tour last year I was camped at a Forest Village called Balapur, where all day long, and till after dusk, we heard an incessant call from a *Sarus* crane. On the second day I enquired why the bird was calling in this

extraordinary manner, and was informed by the villagers that about four months previous a servant of one of the adjoining Malguzars had shot the mate of this bird, since when she was crying. It is now 16 months since this occurred, and I have just left the village in the fields of which the male was shot, to find the bird still in the identical spot she was last year, and continuing this wail, which seems to me as extraordinary as it is pathetic. The locality is not one where *Sarus* are found, and I fancy until some others turn up, this bird will go on calling for her mate. The call is difficult to explain, it is just one note repeated at intervals of about a half minute for short periods practically all day long. I have heard the note before, when these birds have warned one another preparatory to taking flight. I have heard it said that these birds die of grief when one or the other dies, and although this one has not died, there is no doubt that the bird has shown a remarkable memory, coupled with faithfulness, which, for a parallel, is difficult to find.

D. C. MCDONALD, F.F.S.,
Divisional Forest Officer,
Chhindwara Division, C. P.

EXTRACTS.

THE TIMBER RESOURCES OF INDIA.

In a recent review of India's timber resources, a *Financial Times'* correspondent urges the desirability of pursuing a bolder policy in regard to capital expenditure on forest improvements in India and Burma. While paying a well-merited tribute to the judgment and ability with which India's forests have been dealt with in the past, he suggests that the time has come when the raising of capital for productive expenditure should be considered in the case of forests as much as in irrigation and railway projects.

"Is India wise", asks the correspondent, "in spending on forest improvements merely such sums as can be spared from revenue?" The question admits but one answer if thought is given to the innumerable directions in which the revenues, trade and industries of the country would benefit by the development of India's forests to their economic maximum.

The proportion of India's public debt invested in forests is less than £250,000 sterling, as compared with £67,000,000 in-

vested in irrigation, and over £450,000,000 in railways. Under the management of the State Department, the forest lands of India and Burma aggregate about 160,000,000 acres, approximately the same as the area of the national forests of the United States Even under the present conservative system they yield a net annual profit of over £1,500,000 combined with a steady appreciation in capital value, and the scope for the employment of additional funds, to give a substantially higher return than the rate at which Government borrowings can now be effected, is well nigh illimitable. The wider standpoint of Imperial needs in the recently published report of the Forestry Sub-Committee of the Imperial Conference appearing in the appendices to the summary of the Conference's proceedings, supplies the correspondent's contention with striking support.

The Sub-Committee states that there are few subjects concerning the general well being of individual parts of the Empire, and of the Empire as a whole, which require more earnest consideration than that of the rational use and development of forests. There is no need to remind those concerned in newspaper production that available supplies of the principal timbers of commerce are rapidly approaching exhaustion.

The outlook with regard to the world's supply of softwoods constituting about 80 per cent. of the industrial demand is particularly unsatisfactory. The United States, at present, consume only nearly half of the world's umber production and its own softwood resources will soon be limited to the few Western States. When they are exhausted, it will be compelled to seek its supplies almost entirely from the British Empire, and within a period of under 30 years, a serious shortage with all its attendant evils seems inevitable.

In the case of hardwoods, the position is, fortunately, not so critical. The problem which confronts the forestry authorities throughout the Empire, however, is to determine the extent to which certain hardwoods from its great tropical forests can be transformed into efficient substitutes for the soft varieties. India with its increasing annual outturn, consisting chiefly of hardwoods, has a special interest in such an enquiry, for within the

period during which the expected world shortage will occur, its exportable surplus is likely to attain its greatest dimensions —[*Timber News*, *18th February* 1927.]

THE IMPERIAL FORESTRY INSTITUTE.

Some comment is called for on the note on the Imperial Forestry Institute which appeared in *Nature* of January 15th, page 96, and which is likely to produce a wrong impression in the minds of those unacquainted with the facts. With reference to a proposal to spend a sum of £75,000 on the erection of new buildings to accommodate the Imperial Forestry Institute at Oxford, the following observation is made :—"On the face of it the scheme appears to be a laudable one. Nevertheless it would seem to demand further careful consideration if this money or the bulk of it is to be provided from the Treasury." As there has been no suggestion that the Treasury should make any contribution towards the scheme, the fears expressed in regard to national expenditure may in this instance be set at rest.

The note concludes with the following passage :—"Two points appear to demand a public and unbiassed inquiry before the Government is committed to the scheme; they are (1) Are not the existing schools of forestry capable of giving all the education required, both up to the degree and post-graduate, and to undertake research ? (2) Is it advisabe to shut up forestry education in water-tight compartments?" The writer is apparently not aware that such an inquiry was carried out a few years ago by an Interdepartmental Committee on Imperial Forestry Education, which issued in 1921 a report published as Command Paper 1166. In this report both the above questions are definitely answered in the negative. In proposing the establishment of a central institution for higher training and research in forestry the Committee made it clear that there was no intention of interfering with the work done by university schools of forestry, and provided the training of these was maintained at a required standard, it recommended that selected students from these schools should be eligible for admission to the central institution. The Committee may be

presumed to have conducted its inquiries in an impartial manner, it visited the universities of Oxford, Cambridge, Bangor and Edinburgh, and also took evidence from other universities interested in forestry, and in selecting Oxford as the site of the future forestry institute we may assume that it selected that place which it considered most suitable for the end in view.

Apart from the Interdepartmental Committee, the question was carefully considered by two separate Empire Forestry Conferences, one held in London in 1920 and other in Canada in 1923. At both Conferences the inadequacy of the existing arrangements for higher training and research in forestry was commented on, and the necessity for establishing a central institution for the needs of forestry in the British Empire was urged. The Interdepartmental Committee's recommendations were endorsed by the second Empire Forestry Conference and also by the Imperial Economic Conference held in London in 1923. The Imperial Forestry Institute was accordingly established at Oxford and started work in October 1924. Should any readers of *Nature* be interested in the progress actually made so far, I shall be pleased to send them a copy of the second annual report.

R. S. TROUP,
Imperial Forestry Institute,
Oxford, January 19th.

If under "Treasury" Prof. Troup includes the Colonial Office and Forestry Commission (the latter two offices defraying the bulk of the expenses of the Institute at present) the taxpayer, whether in Britain or overseas, will be relieved to have the assurance.

Prof. Troup's somewhat *ex parte* account of the proceedings leading up to the inauguration of the Institute in 1924 has in one form or another appeared on several occasions in the Press. He does not, however, appear to realise that a growing body of scientific opinion at the back of the representations which the authorities of the universities of Cambridge and Edinburgh placed before the Secretary of State for the Colonies and members of the Forestry Commission on the subject of concentration of (State-

subsidised) post-graduate forestry work of all kinds at one university. The authorities of the two universities stated quite definitely that they had no intention of giving up the post-graduate courses they had already inaugurated, and all they asked for was an "open door." It is understood that the Secretary of State accorded a sympathetic hearing, and intimated that whilst nothing could be done at the moment, the experiment was only made for a five-year period and would be open to a reconsideration at the end of the period.—*THE WRITER OF THE NOTE.*

[*Nature, Vol.* 119, *No* 2988, 5*th February* 1927.]

FORMULAS AND COMMONSENSE.

The human mind, apparently, is not given to traveling a straight line. From one extreme it goes to another. When viewed in abstract and historic perspective, the curve is a smooth one. And this may be a natural course. Within our brief development of forest thought in this country, we have done considerable zigzag thinking.

Not more than a decade ago, we went almost wild in our field research work about instrumental measurements. We thought that all problems could be easily solved if only we hung or sunk a few maximum and minimum thermometers in the air or soil; whirled psychrometers; scattered rain gauges over the cut-over land and the old forest; carried photometers in our hip pockets, and exposed Livingston's porous cup atmometers. We did all this and still the problems evaded solution. The instruments could not substitute for grey matter.

We still use the instruments, and they are very serviceable, but we now try to temper them with reason and judgment. We found that instrumentation is merely a means toward and not the solution of the problems themselves

Just now we are carried away with another strong passion this time in the field of forest mensuration. We talk with almost religious fervour of biometry, hyperbolic, parabolic and exponential curves; of anamorphism; of normal yield tables giving values

with the precision of a fraction of a per cent; and brand as ignoramuses those who still rely upon impirical facts, rules of thumb, and other prosaic but serviceable experience gained through years of work in the woods. Like the old forest mensuration alchemists, Kuntze and Bauer, we are again chasing the will-o'-the-wisp—*universal laws of tree growth*.

This new movement, just as our earlier infatuation with instrumental measurements, is a wholesome sign of minds at work and of lack of complacency and intellectual smugness. Much good will result from it, provided formula-hunting does not become a fetish, an end in itself. The statistical method again is only a means toward but not the solution of the manifold problems of forest growth. No simple or multiple correlation will help any researcher, unless he knows fully what factors are worth correlating.

There is a serious doubt that our administrators, who are still helpless in the face of a wasteful utilization in which some 70 per cent. of the volume of a tree is left unused, will become over-enthusiastic over formulas which give values with precision to the fraction of a per cent., will become readily converted to normal yield tables when they know that normal stands occur on only infinitely small areas and that such stands are the exception rather than the rule, and that the bulk of the forest with which they have to deal are battered, fire-ridden, insect-eaten, understocked stands.

Shall we blame them if they look upon researchers for universal laws as academic folks, devoid of sense of reality? We need research in the field of forest mensuration—and lots of it—but research directed toward the solution of every-day problems encountered in the woods.

It is probably inevitable that science will always be and should be ahead of practice, but if science and practice are to be mutually benefited, a bridge must be built across the gap; a bridge of commonsense, a bridge of sympathetic understanding of the immediate, practical problems.

The researchers cannot offer the men in the woods stones when they are clamouring for bread.

The way to approach this task is not by developing super-refined methods of determining growth and yield, but by taking the present-day crude methods and making them more accurate, more serviceable, and more generally known.

Let the researcher leave the quietness of his study room and go into the woods, and there jot down the practical difficulties and problems as they are encountered, and let him try to solve them in a way that can give immediate relief. Otherwise, we shall have on one hand haggard, distracted, practical men, who do not have the simplest tools with which to work in the woods, and on the other hand a small crowd of high-brows, chasing for universal laws of growth

What we need is scientific research, tempered with common sense.—[*Journal of Forestry, Vol. XXV No. 1, January 1927.*]

WORLD'S TIMBER RESOURCES.

IMPERIAL CONFERENCE SEES SHORTAGE IN SIGHT.

The report submitted to the Imperial Conference, concluded on Tuesday at Downing Street, by the Forestry Sub-Committee, which numbered among its members Lord Lovat, Chairman, Forestry Commission, Sir J. Stirling Maxwell, Bart., Empire Forestry Association, Mr. R. L. Robinson, Forestry Commission and Professor R. S. Troup, Imperial Forestry Institute for Britain, and Mr. A. C. Forbes, Director of Forestry, Department of Lands and Agriculture, for the Irish Free State, included the following statements :—

The outlook with regard to the world's supply of softwoods which constitute about 80 per cent. of the wood used for industrial purposes, is distinctly unsatisfactory. The outlook with regard to the hardwoods of temperate countries is also unsatisfactory, but it will no doubt be possible to supplement the supply to some extent by having recourse to tropical hardwoods. There are, however, difficulties of various kinds in the way of replacement of temperate by tropical hardwoods. Apart from the question of the availability of supplies of softwoods and hardwoods in sufficient quantities to meet demands, there are very

important internal questions, both social and economic, which point to the necessity of all countries maintaining and extending, where possible, their existing forest areas under a system of management based on sustained production of timber. They believe that there are few subjects concerning the general well-being of individual parts of the Empire and of the Empire as a whole, which require more earnest consideration by statesmen than this subject of the rational use and development of forests.

The Sub-Committee have considered and commend for approval the preliminary arrangements for the work of the Empire Forestry Conference to be held in Australia and New Zealand in 1928. They have also made suggestions, which the Standing Committee on Empire Forestry will take up, as to the specialists who should be delegated to attend the Conference in order to render it thoroughly effective. They desire to urge the importance of every part of the Empire making adequate preparations for the Forestry Conference and being suitably represented.

They are of opinion that there is a useful purpose to be served by an Imperial Forestry Bureau to act as a clearing-house for information; and that the matter in all its aspects should be referred to the Empire Forestry Conference, 1928, for consideration and report.

The Sub-Committee are impressed by the useful work which has already been done at the Imperial Forestry Institute at Oxford. They particularly desire to draw attention to the opportunities which are afforded to foresters from overseas to study in and from this Institute the results of long-established scientific management in European forests.

In Appendix I, in the course of a note on the world's timber position, Mr. Fraser Story, Forestry Commission of Great Britain, says: A review of the forestry situation throughout the world leads to the conclusion that available supplies of the principal timbers of commerce are rapidly approaching exhaustion. There is every likelihood that in less than 30 years a shortage of softwoods will be severely felt. Any limitation of supply with consequent rise in prices must have a most damaging effect on

the industries of the Empire. Statistical information is far from complete, but the available data disclose facts which deserve attention.

The three main classes of timber (softwoods, temperate and tropical hardwoods) are distributed very unevenly over the surface of the globe. About 90 per cent. of the world's softwoods are located in North America, North Europe and Siberia. Temperate hardwoods, which frequently occur mixed with softwoods, are principally found in Central and Southern Europe and the adjoining parts of Asia and in Eastern United States. Over 75 per cent. of the tropical hardwoods occur in the great forests of South America, India and East Africa. Temperate and tropical hardwoods taken together occupy about 65 per cent. of the world's forest area.

Apart from wood used for fuel, the world demand is for softwoods—the product of pine, spruce, larch and fir. About 80 per cent of the saw timber of the world is of this class. On this account it is advisable to describe briefly the forest position in the principal softwood areas :—

Europe.—Although 33 per cent. of the total land area of Europe is under forest, the consumption of softwoods exceeds growth by about 3,000 million cubic feet annually. This state of affairs is due to the enormous importation of timber into Great Britain and other West-European countries where the home-grown timber supply is small in comparison to the amount utilised. Reliable statistics relating to Russia are at present unobtainable. It is well known that enormous forests of pine and spruce exist, but the great bulk of these resources cannot become available unless means of transport improve and timber commands much higher prices.

Siberia.—The softwood belt bordering on the Arctic Ocean is continued through Siberia to Eastern Asia. There are immense forests in Siberia, but for the most part they are inaccessible. There are few rivers suitable for the floating of logs, and owing to the sparsity of the population little incentive is given to rail-

way construction. In addition, forest labour is almost unobtainable. If eventually these difficulties are overcome there is every prospect of the timber supply being diverted to Japan, China and the United States of America.

Canada.—The eastern half of Canada has been to a great extent depleted of saw-mill timber and it is becoming increasingly difficult for the remaining forest to meet the extraordinary demands made upon them by the wood-pulp industry. According to the most recent statistics the loss from fire, insects and fungi equals the amount of timber felled each year, and only 27 per cent. of the original forest is left. Three-quarters of the saw timber of the Dominion is in British Columbia, and at the present rate of consumption virgin softwood resources are not expected to last more than 25 years. After that the country will have to depend on second growth forests on cut-over areas.

United States of America.—The original forest area of 822 million acres in the U. S. A. has been reduced to 463 million acres, of which only 137 million acres carry virgin timber. This last mentioned area is being cleared at the rate of 5½ million acres per annum, so that as in the case of Canada, there appears to be only about 25 years' supply, apart from the produce of second-growth areas. The United States consumes about half of the world's lumber, and its softwood resources will soon be limited to the few Western States. When this supply is finished the demand will still be there, and although a reduction in consumption may take place with enhanced prices the fact remains that the British Empire will have to face the competition of this great consuming force. Already, according to official records 83 per cent. of Canada's trade in forest products is with the United States. The amount supplied to the United States is constantly increasing, whereas the timber shipments to Great Britain from Canada have steadily declined. It is evident that when American forest resources come to an end, and, according to President Coolidge, the time is at hand when the United States will be actually confronted with a

timber shortage, softwoods will be sought for from the source which at present furnishes the British Empire with its supplies

HARDWOODS

The position is not so critical in the case of hardwoods. Not only is there less demand for this class of timber, but the forests producing it are more abundant and more widely distributed throughout the world. Moreover, hardwoods usually regenerate themselves on cut-over areas more easily than conifers, and are much less liable to damage by fire. At the same time most of the accessible temperate hardwoods have been severely culled, while the tropical hardwoods are chiefly found in regions difficult of access and in stands so mixed with apparently worthless species that generally only a small proportion of the total crop is marketable. Tropical hardwoods, although valuable for yielding furniture woods, dye woods and timbers for special purposes, are at present of comparatively small importance, as they contribute less than 3 per cent to the world's timber consumption

The great problem before the Empire is to decide what action should be taken in order to meet the shortage of softwood constructional timber, which in all probability, will overtake the next few generations. This may in part be done by using certain hardwoods from our great tropical forests as substitutes for softwoods — a matter which requires the closest investigation.

In Appendix V to the report a note on the Imperial Forestry Institute, University of Oxford is given by Professor R. S. Troup, F.R.S., in the course of which he recounts the recommendations of the British Empire Forestry Conferences in 1920 and 1923, and adds: —

During recent years increasing attention has been focussed on the risks attendant on the diminution of the world's timber supplies and the serious situation which is likely to arise before long if steps are not taken to extend the application of scientific methods of forest organisation and silviculture. The total forest area of the British Empire is estimated at 1,837,000 square miles of which some 685,000 square miles are at present accessible and

marketable. Much of this area has, however, been depleted by wasteful methods of working and will require very careful handling. The importance of providing a thoroughly capable staff to administer and work this vast property, and of training research workers to deal with the many problems affecting its management, scarcely requires to be emphasised. This question, among others, was discussed by the British Empire Forestry Conference which was held in London in 1920 and attended by delegates from all parts of the Empire. The Conference recognised that one of the first essentials was to provide for the more efficient training of forest officers and to afford better facilities for research in the various branches of forestry. The measures recommended included the establishment in the United Kingdom of a central institution which should undertake the higher training of forest officers for the Empire, and should also be a centre of research into the formation, tending and protection of forests.

An Interdepartmental Committee was thereupon appointed to make proposals regarding the location and organisation of such an institution. This Committee issued in 1921 a report which recommended the establishment at Oxford, in close connection with the University, of a central institution for the higher training of forest officers, for the provision of special and "refresher" courses for officers already serving, and for the conduct of research in forest production. Incidentally, the Committee held that existing or contemplated schools of forestry should not be relieved of the responsibility of furnishing a good general training in forestry, but that the central institution should be responsible for further instruction in more advanced and specialised work by students who had already received such a general training, whether in Great Britain or overseas. The second Empire Forestry Conference, held in Canada in 1923, strongly supported this recommendation, and emphasised the necessity for taking immediate action. These views were endorsed by the Imperial Economic Conference held in London the same year.

The Imperial Forestry Institute was accordingly established at Oxford in October 1924, and has just completed the second year of its existence. It is a University institution, the Professor

of Forestry being its Director, and is under the control of a Board of Governors representing the University, the Colonial Office, the Forestry Commission, and the Empire Forestry Association. It is supported mainly by funds provided by the various non-self-governing Colonies and Dependencies and the Forestry Commission.

During its first two years the Institute has made excellent progress, and has fully justified its creation in every way. During the first year 22 students attended courses of instruction. During the second year the number was 44, while new admissions at the beginning of the third year indicate that this number is likely to be exceeded during the year. Important research work is now in full swing, and, given suitable facilities, there is every reason to expect that the Institute will before long become an asset of the greatest importance to the Empire. Already its students have represented, apart from Great Britain, such widely scattered portions of the Empire as Australia, New Zealand, South Africa, India (including Burma), Nigeria, the Gold Coast, Sierra Leone, Kenya, Tanganyika, Nyasaland, Ceylon, Malaya, British Honduras and Cyprus

So far the work of the Institute has been carried on partly in the University School of Forestry and partly in a temporary annexe.

Appendix VI consists of a note on the Empire Forestry Association, 1926, by Sir John Stirling Maxwell, Bart., who says.—

The Association is the outcome of a resolution passed at the first Empire Forestry Conference, held in London in 1920. It was incorporated by Royal Charter on November 1st, 1921 The objects are :—

(i) To create interest and circulate information relating to forestry among all classes in the British Empire.

(ii) To bring about better public recognition of the identity of interest between continuous timber supplies and systematic forest management, and to spread information relating to the commercial utilisation of Empire grown timbers and forest products.

(iii) To form a centre for the Empire for those engaged in forestry and to provide a means of communication between the widely-scattered members.

Membership is open to individuals, organisations and business undertakings interested in forestry and timber utilisation in all parts of the Empire.—[*Timber Trades Journal, Vol. C, No.* 2622.]

BOTANICAL EXPEDITION

London, 21st February.

The Botanist and Explorer Captain Kingdon Ward has returned to England after a 12 months' journey in Burma, Assam and Tibet. Interviewed by Reuter he stated that the expedition, which had been financed by the Royal Society and the Percy Sladen Memorial Fund, had produced about 5,000 specimens of plants, birds and insects, which had been forwarded to the Natural History Museum.—Reuter [*Pioneer.*]

(Capt. Ward is a son of Professor Marshall Ward formerly Professor of Botany at Coopers Hill.—Hon. Ed.)

Fig. 1. View of Rosin Pine Forest.

F g. 2. Coopers mak ng Rosin Casks.

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INDIAN FORESTER

JULY 1927.

THE RESIN INDUSTRY IN INDIA.

BY A. J GIBSON, I.F.S., F.C.H., F.L.S., F Z.S., AND
C. T. MASON M.A., A.I.C., F.C.S.

The Resin Industry : What it is.

To enlighten those who are unacquainted with our subject we will commence by defining its scope as follows :—

The Resin Industry in India consists in :—(1) the collection of crude gum resin from the pine tree in the forests, (2) the treatment of the crude gum at a distillery to produce turpentine, rosin and a variety of by-products, (3) the marketing of these commodities in India and abroad

Historical.

Some thirty years ago the thoughts of some Forest Officers in the United Provinces and the Punjab turned to the possibility of a resin industry in India. 'Tapping' the *chir* pine to obtain resin was commenced on a small scale, and the results of the experiments were such that it was decided to continue experiments on a commercial scale in both provinces. In this article we shall confine ourselves to the development in the Punjab.

The Punjab Government in 1910 wisely took a long view of the matter and deputed a forest officer to study the subject at first hand in the two homes of the industry, France and America. As an immediate result the Jallo resin factory came into being as a going concern in 1914. From then onwards progress has been rapid, the first crude experiments with a fire still in 1898 have given place to the absolutely up-to-date and highly technical plant now in use ; a local sale has expanded into a large export

trade and the quality of the products has won a recognised status on the markets of the world

Collection of the Gum.

Every visitor to a hill station is conversant with the 'gummy' properties of a pine tree. Pine resin exists in the pine tree as a clear white viscid fluid Its formation and function is not completely understood at present, but one of its chief services to the tree is that of protecting any wound from the injurious effect of air, animals, fungi and insects. It is also a deterrent to all forms of boring parasites. The pine tree which has been worked in India for the commercial production of resin is the long leafed or *chir* pine. Its botanical name is *Pinus longifolia.*

Pinus Khasya, Pinus Gerardiana, Pinus Merkusii and *Pinus excelsa* also produce suitable gum, but for reasons of accessibility these are not 'tapped' at present.

The *chir* pine is abundantly distributed at a height of 2,000—6,000 ft. along the lower slopes of the Himalayas, extending roughly from the Kabul river on the west to the watershed of the Ganges on the east The resin is obtained by the French method of 'tapping' the tree. This is carried out by the Forest department, who adopt a conservative system whereby the resin capacity of the tree is utilised to a maximum with the minimum injury to the wood and no encroachment on the capital wealth of the forests.

A blaze of carefully chosen dimensions is cut on the tree close to the ground, below this blaze a tin lip is inserted and beneath this a clay cup is suspended by a nail.

The resin flowing from the freshly cut blaze falls on to the tin lip which guides it into the clay cup. Every week a labourer visits the blaze and collects the resin; at the same time he performs the operation known as refreshing the blaze This consists in cutting a thin silver of wood from the top of the blaze. This serves a two-fold purpose, it re-opens any resin ducts that may have become choked with solified resin and it also has a physiological action in stimulating the resin producing cells to further activity. One blaze will yield from $1\frac{1}{4}-2\frac{1}{2}$ seers ($2\frac{1}{2}$—5 lbs., of resin in a season, but from this must be deducted a percentage due to mishaps to clay cups The irresistible attraction a

clay cup has for the stone throwing propensities of the small boy is a *source of trial* to the forest ranger. On an average eight trees must be tapped for a whole season in order to produce a gallon of best turpentine. The resin collected from the cups is filtered and poured into four gallon tins supplied from the factory manufactory. In these it is despatched by men, pony, camel or bullock cart to the nearest railhead for transport to the factory.

Pine Resin and its Constituents.

Before describing the treatment at the factory it will be necessary to briefly describe what resin is. Pine resin is essentially a solution of rosin in oil of turpentine and the process we are about to describe may be summarised as consisting in the separation of these two constituents by the process of distillation. In actual practice, however, this seemingly simple operation is fraught with technical difficulties. Chief of these is the *fact that* the resin from the *chir* pine contains an objectionable high boiling point oil which must be removed from the turpentine and rosin if they are to adhere to the high standard that the factory maintains. This objectionable oil is not present in the gum resins of America or France and is peculiar to the resin of *Pinus longifolia*. On this account Dr. Simonsen, the expert Forest Chemist at Dehra Dun, most appropriately christened this constituent *Longifolene*. Actually the elaborate precautions necessary for the removal of this oil has resulted in the turpentine marketed as best quality being superior in many respects to French and American

For the benefit of the technical reader the following is the analysis of the crude oil before rectification The rosin is very similar to French and American :—

Analysis of Crude Turpentine Oil from Pinus longifolia.

α – pinene ...	... 25	per cent.
β – pinene ...	... 10	,,
Carene ...	... 38	,,
Longifolene ...	... 20	,,
Loss and Residue ...	... 7	,,
	100	,,

Factory Process.—Preliminary Treatment.

By the time the resin arrives at the factory it has become a semi-crystalline mass of too thick a consistency to be poured out of the tins. The tins must be cut round three sides of the lid, and the flap thus formed pulled back, before the resin can be removed. In winter it is even necessary to heat the tins in a steam chamber before this operation. This method of cutting enables the tins to be resoldered and used again. The resin is scraped out from the tins and emptied into a pit into which the lower end of a helical elevating screw dips. Any resin which may adhere to the sides of the tins is melted out by means of a jet of steam. The screw rotated by a small steam engine, hoists the resin into a concrete mixing tank. In this tank the resin is thoroughly mixed with turpentine from a previous distillation and heated to a temperature of approximately 100°C. In the molten condition it is passed through an autoclave containing graduated sieves. These remove any pine needles, chips of bark, leaves etc., which may have escaped the filtration in the forests. The reason for the addition of turpentine and the heating in the mixer is that the density of the resin may be so reduced that it may pass through the sieves without difficulty and the subsequent distillation may be facilitated; also the difference between the density of the resin and the fine suspended dirt, which cannot be retained on the sieves of the autoclave, is thereby accentuated, and the latter settles out more rapidly in the decantation vats mentioned below. The resin is then hoisted by means of a centrifugal pump to one or two decantation vats, where it is allowed to rest for 14 hours. After its period of rest in the decantation vat any fine dirt or water is drawn off from the bottom of the vat, but the clean resin is connected by a pipe and flexible hose to the still.

Factory Process.—Distillation.

The still consists of a vertical column about 15ft in length traversed by numerous copper tubes. These tubes are surrounded by steam at a pressure of 140 lbs. per sq. inch. The resin is drawn upward through the still by the aid of a vacuum, the latter

Fig. 3. A Section of the Factory.

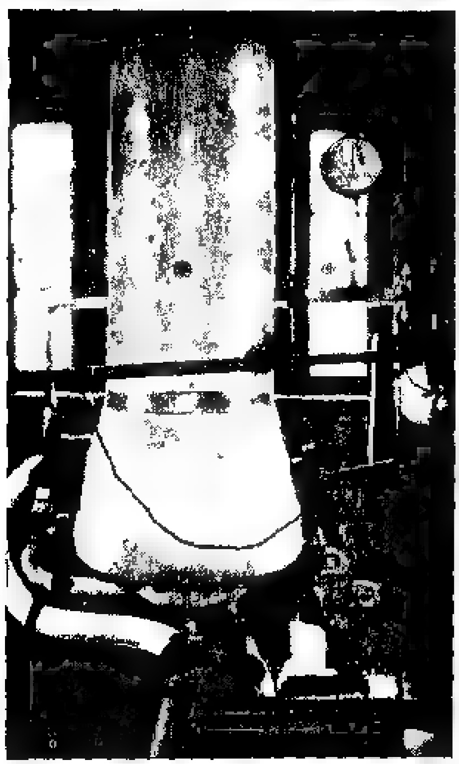


Fig. 4. A portion of a Vacuum Still.

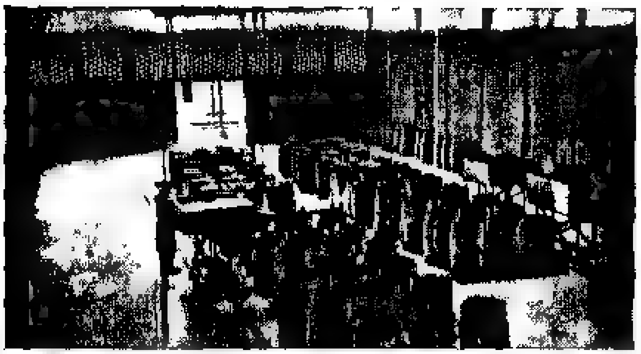


Fig. 5. Filling Casks with Molten Rosin.

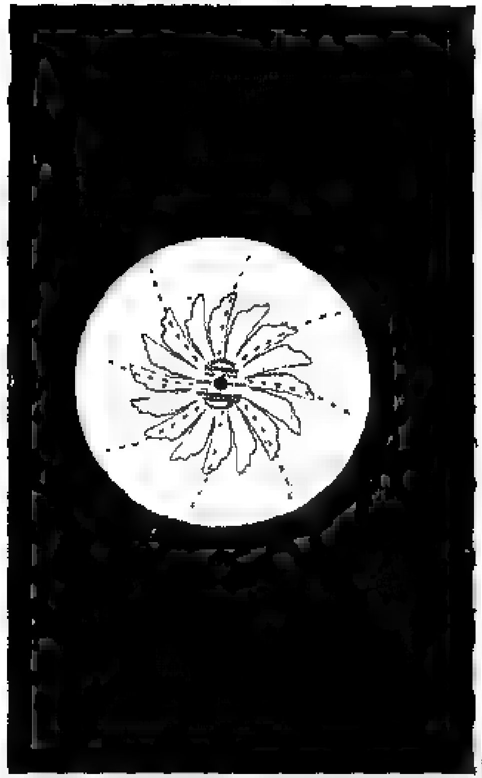


Fig. 6. A Thermograph Control Chart recording Stil Temperatures.

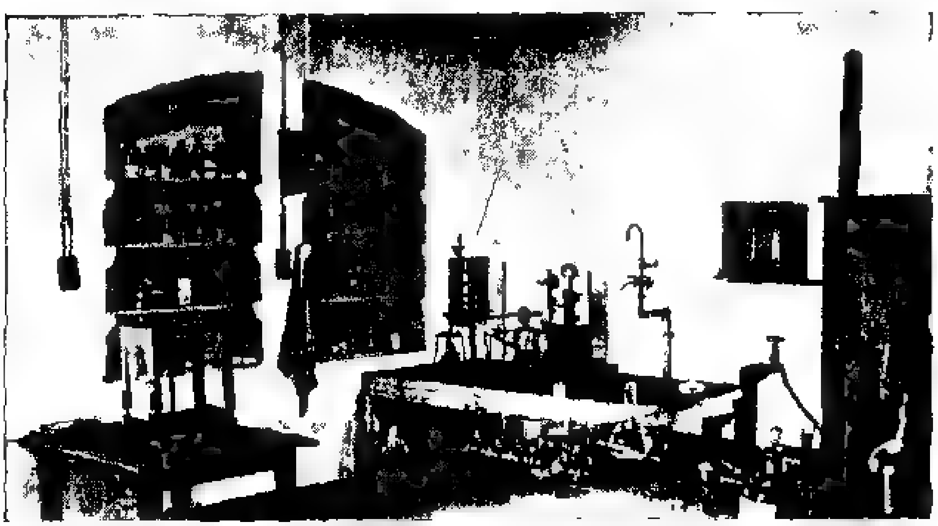


Fig. 7. A corner of the Test and Research Laboratory.

being produced by two steam jets working on the suction injecter system. During distillation the maintenance of the vacuum is assisted by the condensation of the turpentine in the condensers.

By the time the resin is drawn to the top of the still, the heat and vacuum have resolved it into its constituents, consisting of turpentine vapour and molten rosin.

The turpentine vapour passing into the still head is drawn on through a series of water cooled fractionating columns, the fractions of highest boiling point condensing in the first of these and the lighter fractions in the last. Any vapour passing all these is trapped by a shower bath of cold water. From these condensers the turpentine descends by barometric columns to separating tanks where it is automatically separated from the heavier water, it then passes through chemical purifiers to storage tanks to await further treatment and redistillation if necessary.

Meanwhile the molten rosin flowing from the top of the tubes into the still head passes down a barometric column, where it meets jets of steam which remove the last traces of turpentine, the latter joining the main bulk of turpentine in the condensers.

At the bottom of the barometric column the rosin passes through sieves into wooden vats and from these after slight cooling it is conveyed, still in the molten state, by trollies and poured into casks where it slowly solidifies

The process described is a continuous one, the slowly ascending resin being separated into a steadily descending flow of turpentine and rosin.

Grading and Standardising.—Purity of Products.

In modern industry it is impossible to take too much trouble over the purity and grading of products. Attention to these two points goes a long way to obtaining the good will of the customer and, for an export trade competing with American products *standardised by law*, it is a matter of vital importance.

At Jallo there is a modern and well equipped laboratory designed for routine and research work. Here all products are tested by trained chemists before they leave the factory.

Rosin is graded according to the American standards familiar to the trade as X, W.W , W G., N. B., etc.

Every tank of turpentine is tested by distillation, colour, smell, specific gravity, acidity, evaporation, etc. Various grades are marketed, but the standard for the first quality is exceedingly high and can compete with any turpentine on the market.

Packing and Despatch.

Not less important than purity is the giving of correct measure and the choice of suitable containers.

In the case of rosin the largest consumer is not, as some people imagine, the violinist, but the manufacturer on a big scale of soap and other commodities, so rosin is sold by weight in casks.

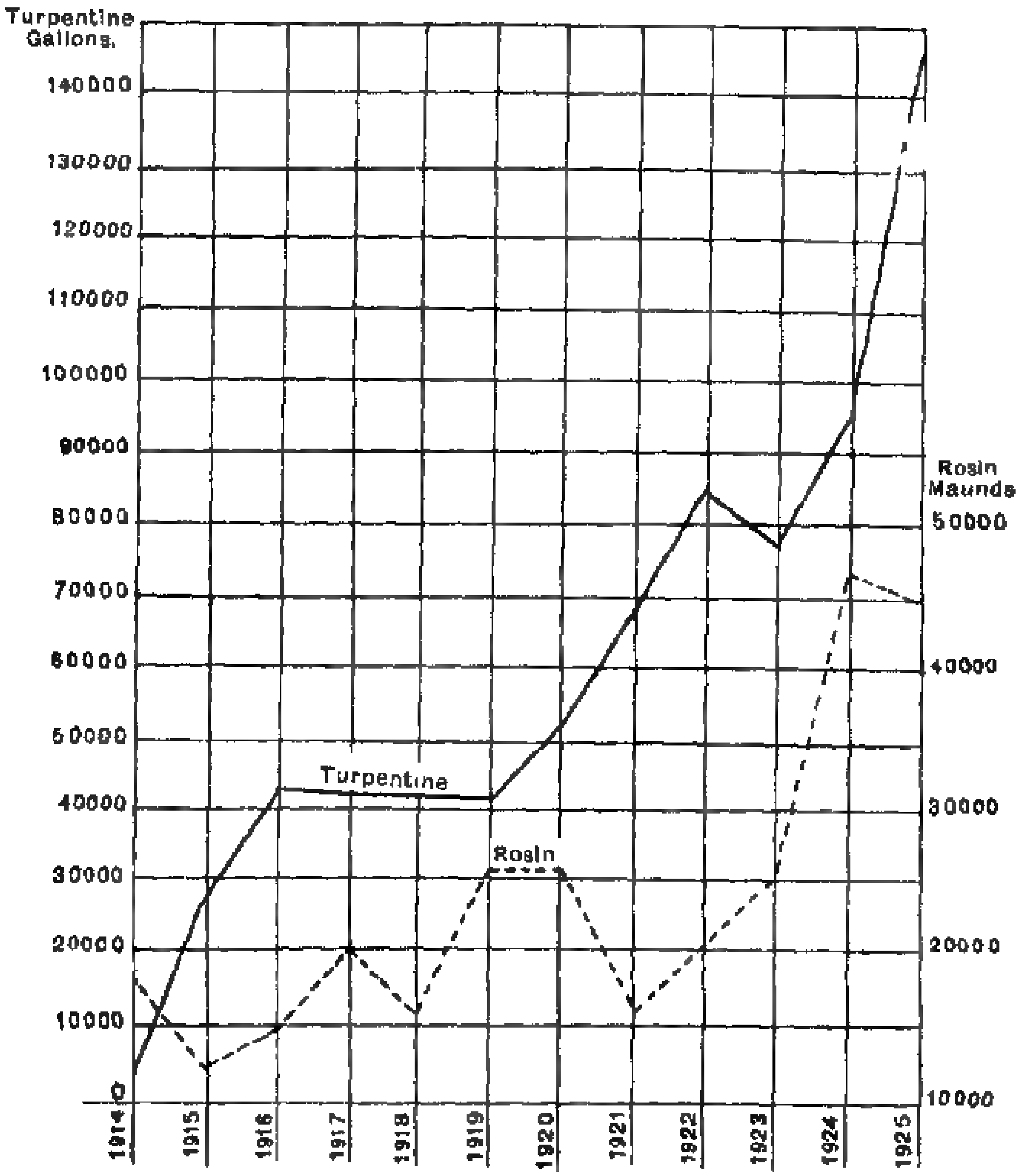
Turpentine is sold by drums or tins varying from 150 to $\frac{1}{2}$ gallons in capacity. Both casks and smaller drums are manufactured at the factory.

The drums are filled by an electrically controlled automatic filling machine, thus ensuring the delivery of a constant quantity to each container. Acting upon the policy that a satisfied customer is the best advertisement and to avoid complaints the quantity arranged to be delivered per container is such as to give a small excess to the customer. Goods are despatched from the factory private siding in waggon loads to distributing centres.

Uses of Rosin and Turpentine.

The uses of rosin and turpentine are many and varied. Of course the greatest use for turpentine is in the paint and varnish trade, where it functions both as a volatile thinner and to accelerate the oxidation of drying oils. This second function of turpentine is conveniently overlooked by the vendors of turpentine substitute and the so-called mineral turpentines. These never have and never can take the place of turpentine in this respect. As thinners they may prove passable but from their innate chemical properties they are incapable of chemically reacting with linseed or other drying oils to form that tough elastic skin so

JALLO RESIN FACTORY.



SALES OF TURPENTINE AND ROSIN

The sales graph shown above admirably illustrates the progress of the Resin Industry in India.

No. 125-1,860

necessary for good paint work. Turpentine is put to other uses as follow :—

As an ingredient of printing inks, belting greases, stove polishes, sealing wax, paint removers, and pharmaceutical preparations. As a solvent for waxes in shoe, leather, floor, and furniture polishes.

In the manufacture of patent leather and to prevent 'bleeding' in the manufacture of cotton and woollen print goods.

As a raw material for the production of synthetic camphor and indirectly, celluloid and explosives.

The above are but a selection of the infinite variety of products with which turpentine is associated in some form or other.

Rosin is perhaps even more diverse in its applications. It is an ingredient of soaps and varnishes. It is used in the sizing of paper and as an electrical insulator. It enters into the composition of gramophone records and in war it finds a use as a filler in shrapnel shells. We cannot do better than quote from an article in the "Liverpool Daily Post" which concludes a long description of the applications of rosin as follows :—

"It is an ingredient of the anti-fouling composition with which a ship is painted, and of the linoleum with which you cover your floor and of the paste of which you cover your furniture. There is no escape from rosin, for it was used in the tanning of the very boots in which you may attempt to run away from it."

Associated with Jallo there now exists 'The Jallo Subsidiary Industries Company,' which is rapidly making commercial headway with many of the products outlined above.

Conclusion. An Asset to India.

In conclusion we feel justified in remarking that in these days of political recrimination and abuse of Government's industrial policy the Government may be heartily congratulated on this enterprise. Not only has it proved a direct financial asset to the Government, but its indirect assistance to allied industries can only be conjectured as running into many lacs of rupees.

A SALWEEN ADVENTURE.

(Through the Hat-gyi on a Raft.)

Of all the big rivers draining that part of the East known as Further India, the Salween is one of the biggest and at the same time least explored. Rising amongst the lofty heights of Tibet its actual source is yet undiscovered and little is known of it beyond the fact that it lies somewhere near those of the Brahmaputra, Irrawaddy, Mekong and Yangtse. Its deep swirling waters flow down through the Shan States and for some distance form the boundary between Burma and Siam as far as the mouth of the Thaungyin river a big tributary on the left bank of the Salween—up which the boundary runs Below the Thaungyin mouth the banks rise more and more precipitously until they form a narrow gorge, in places more than 1,000 feet deep, through which the waters of the Salween pour in a series of rapids ending at the narrowest point of all in a mass of jutting rocks and seething waters known as the Hat gyi or great rapid.

Below the Hat-gyi three smaller rapids are encountered before the river broadens out below Sazeik into a quiet, wide stream that flows in unbroken tranquility to pour its waters into the gulf of Martaban some 200 miles away. The Hat-gyi and the numerous smaller rapids above and below form an impassable barrier against any form of navigation and the defiles are indeed so difficult of passage that few natives only have been through. Soon after the first Burmese war a Naval Officer made a trip as far as the Hat-gyi and sixty years later an Irrawaddy Flotilla Captain made the same journey with a view to navigation or transhipment but, after viewing the lower rapids and then being confronted with the Hat-gyi, it was decided as impossible; since then, to the best of my knowledge, I am the first European to attempt the complete journey. It was, however, in no spirit of exploration or idle curiosity that I undertook the job which was to provide me with sufficient thrills to last me many a long day Engaged in the business of extracting teak from the Thaungyin forests it became necessary for me to endeavour to trace certain missing logs which were believed to have stranded in the long

Fig. 1. Salween River. Hat-gyi taken from a rock below the rapid and 50 feet above the water.

Fig. 2. Salween River. General view just below Hat-gyi.

stretch of rapids known generally as the Hat-gyi. Accordingly on the 24th of April, when the Salween was at its lowest, I started from the mouth of the Thaungyin river accompanied by my boy and four followers, experienced raftsmen, to explore the famous rapids.

As a good deal of exceedingly difficult climbing was likely to be met with it was essential to travel as light as possible and rations for six days only were carried, as we reckoned that if successful we should emerge from the gorge and be amongst civilisation well within that time and in the other event rations were likely to have no further interest for us.

For the first day we followed the east bank and, after a very strenuous and tiring day's climbing across precipitous rocks—mostly of volcanic origin with razor like edges that removed one's cuticle at the least touch,—succeeded in covering about 10 miles. On the way I shot a *gyi* (barking deer). All of us were fully loaded and unable to carry much exteriorly, consequently a meal became necessary to economise in space and fortify ourselves against the arduous task still in front of us. Some four miles below the Thaungyin mouth we passed one big rapid known as the Melle-hat and two smaller rapids which were evidently considered locally as too insignificant to deserve nomenclature, although each of them was anything from half to one mile in length, broken here and there by huge rocks and with the stream running at about 15 to 20 knots throwing up waves from 3 to 4 feet high that burst in foam and spray around the obstructions.

Luck favoured us this day as at the end of our march we encountered some bamboo cutters completing a big raft of some 400 bamboos with the intention of launching it in the hopes of its being successfully carried through the rapids and salved at leisure lower down. Bamboo, being the universal house-building material and floating medium for hardwoods, is in great demand and being scarce below the Hat-gyi, a big trade is done annually by bamboo cutters sending down large rafts from up above. They were only too pleased that we should make use of their raft as far as we found it feasible since the further we took it the less chance there was of its stranding or remaining, perhaps for weeks, locked in the

embrace of one of the many big whirlpools with which the Hatgyi abounds. That evening, too, we received a visit from a member of one of the Karen hill tribes who told us a most interesting story of an adventure he had had some years before when trying to go down through the rapids on a raft. Apparently a little way below Melle-hat are two large whirlpools and having successfully run the smaller rapids he avoided the first of these only to butt right into the heart of the second. There he stayed and revolved, only varying the speed of his revolutions according as he approached and withdrew from the vortex, for seven solid days unable to get clear or close enough to the bank to jump ashore, and starving the greater part of the time, since he had taken but little food with him, until at last a change in the level of the river set him free. Of course neither bedding nor blankets could be carried but a bed, and a very comfortable one too I made for myself on a patch of sand between two rocks by digging a hip hole and making a sand pillow lined with plantain leaves. Even the fresh tracks of a tiger on the sand beside my bed failed to keep me awake, in spite of my wholesome respect for his species.

On the 25th we boarded the lugger and cast off. She was a clumsy craft 20 feet square, standing 3 feet out of the water, with no means of control and guided only by Providence. However the fast current kept us fairly clear of obstructions, the few rocks we did hit only knocked us into a parallelogram or re-squared us as the case may be. Our progress was steady and comparatively peaceful until we reached the Maigazaw-hat, a big rapid with two large rocks at its further end. As we entered the grip of the rapid our speed increased until we must have been doing a good 18 to 20 knots. Waves four feet high rose around us and, as our raft made little or no effort to rise to them, the water foamed over us waist deep. The roar of the rapid was deafening and not a little awe inspiring. Nearer and nearer we drew to the final obstacle and to me the gateway seemed to grow ever smaller as we approached. What the others thought about it I do not know but I frankly held my breath as we hit one rock and cannoned the next. I certainly expected the raft to sink but, so buoyant is the

Fig. 3. The Salween rapids.

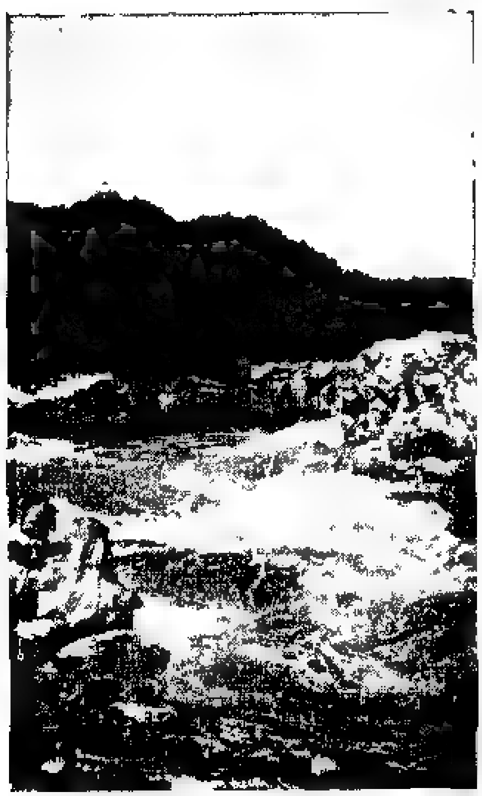


Fig. 4. Salween River. A whirlpool two miles above Sazeik. Half the river flows through this opening, the other half passes through an opening of the same size on the other side of the rock in right of photograph.

bamboo, we only dipped a few inches at each rock and were clear.

A long stretch of untroubled water enabled us to get our breath after this first thrill and it was dusk before we experienced another. This was in the Yaytagone or waterfall-hat. Though not quite as swift as the Maigazaw-hat we found it quite thrilling in the uncertain light and it was finally by luck that we were carried out of the main current into a whirlpool about two-thirds of the way through. I say by luck, for we were now within two miles of the Hat-gyi itself and the thunder of its waters could be heard even above the noise of the rapid we were in. Our chances of effecting a landing below the Yaytagone-hat were very uncertain and to have entered the Hat-gyi by night would most certainly have been the end of all things for us. The whirlpool in which we found ourselves was quite a gentle one and after two or three slow revolutions we were able to get close enough to the bank to secure a landing, though we passed right under and got a thorough drenching from the waterfall in the course of doing so.

Though not appreciated at that moment it was a most beautiful sight, when lying at ease after a good dinner and soothed by an evenly drawing pipe, to watch the waterfall by the light of an almost full moon. Like a broad silver ribbon the waters of this small tributary spread themselves over a big lime-stone ledge some 40 feet above the river and fell thence in a sparkling cascade sheer to the dark waters below. The rush of the rapid added its bass to the tinkling treble of the fall and from afar, throbbing, came the deep diapason of the Hat-gyi.

Next morning early, after leaving a couple of men to tow the raft clear of the whirlpool and launch it into the main current once more, I climbed along the west bank with the rest of the party to the Hat-gyi to await its passage. The Hat-gyi was not nearly so awe-inspiring as I had expected, instead of the deep gorge of my imagination, the rapid is sided by gradually rising hills. The river here narrows down to a stone's throw in width and consists of a waterfall with a drop of 15 feet in a length of

40 feet. The force of the fall is terrific and the clamour of the raging waters absolutely deafening. While we waited for our raft to appear, two big teak logs came floating down and plunged headlong over the fall disappearing in the welter of foam at its foot and only breaking the surface again a full 200 yards below. I thought of our raft and shuddered at what might have happened had we not been able to effect a landing the night before. Nothing could live in such a spot and though the end would have been swift the thought was scarcely one to bring comfort or cheer to any but an intending suicide.

About the middle of the afternoon the raft appeared ful in the middle of the stream and heading swiftly for the fall. Faster and faster it came till at last, seeming to pause for a moment on the very brink, it slid headlong in a sickening plunge. Seconds that seemed like minutes passed before it reappeared at last, a sadly battered wreck. The centre platform was missing, many bamboos broken and the cane lashings stripped as though they had been so much string. Although I do not suppose it was more than 6 or 7 seconds under the water one had some idea of the tremendous forces at work that could hold so buoyant a thing as a four hundred bamboo raft submerged for even so long as that More than ever did I thank my stars I was not a passenger at that stage of the voyage.

We retrieved the remains of our craft from a friendly back-water a mile and a half down stream and working like beavers succeeded in repairing the damage that had been wrought before turning in for the night.

The repairs availed us little, however, for after negotiating the Ooloo-nat the following morning—a short but exceedingly unpleasing rapid situated in a gorge at an awkward bend of the river, where, driven on to a lee shore our craft canted dangerously and was half awash and whence, we emerged safe but soaked to the skin with spray—we met our Waterloo in the Hat-tan-shay, a very long rapid three miles further down. Half way through the rapid after again being swamped we found ourselves in the grip of Charybdis where for two hours we spun round in circles at the rate of ten revolutions per minute. All our efforts to get clear

of the whirlpool proved unavailing and as the raft began to show imminent signs of impending dissolution to say nothing of an ever present likelihood of being swamped we were forced at length to abandon the attempt and try and effect a landing. Fortunately in the course of our revolutions we were swept close to some projecting rocks and, one at a time as we swept by on our circuitous course, each man leaped for safety and landed without mishap.

We were now on the west bank and knew we could not be many miles from Sazeik but one mile on that stretch of bank is in my opinion equivalent to ten Irish miles. We left the raft in Hat-tan-shay at 10 o'clock in the morning and at noon called a halt for a couple of hours and eventually reached Sazeik late in the evening. Here I had hoped to find a village but actually found a hut on each bank and a dug-out boat as a ferry. There are Karen villages but they are situated at considerable distances from the river.

Distances are very hard to judge when one's progress is so slow but I estimate that Hat-gyi to Sazeik is some 10 to 15 miles and practically a continuous gorge. To get along the top of one sheer precipice near Sazeik we had to climb quite a 1,000 feet but, fortunately, the going was not too difficult. On the other hand, at the gorge below Oo.oo-hat the banks are indeed formidable and in spite of the rapids we felt more comfortable on our raft than we should have done on a small ledge of rock some 400 feet up the precipice

Before commencing the journey I had instructed our rafting contractor to send up a big dug-out boat to meet us at Sazeik and, on our arrival we found it waiting for us, a big four-oared boat quite 40 feet in length. We went to bed that night with the comforting thoughts that to-morrow we should have a really safe means of progression but we most certainly changed our minds before many miles had been covered on the way to Shwegun next day. The Salween does not open out into a quiet flowing river until it has reached Kamawkai, about half way between Shwegun and Sazeik, and on the way there our heavy boat was cast about on the many eddies like a straw,

missing rocks by inches. This particular boat was made of *thingan* (*Hopea odorata*), a non-floating wood, and I'm afraid we all longed for the comparative safety of our battered raft because, if one sticks to a bamboo, one is sure to come up some time, but, should a *thingan* boat get submerged, it is no good hanging on. In a quiet way I profess to be able to swim, but I should not be keen to take any chances in this river above Kamawlai.

The remainder of the journey to Shwegun is comparatively well known and fairly uninteresting, we arrived late in the evening and so as to get into Moulmein early on the following day we took the usual type of Burma Rolls Ford-*cum* Heath Robinson car, consisting of much string and many knots, and reached Paan at midnight.

My sand bed on the banks of the river was a luxury compared with the hard deck of the Irrawaddy Flotilla Co.'s launch. Next morning to Moulmein, thus in six days covering 200 miles, the last hundred miles on a well-known route by car and launch.

N. E. K.

THE HAZARA GRAVITY ROPEWAY.

I.—*General Description.* The Hazara Gravity Ropeway is a single span Bi-Cable gravity plant consisting of (*a*) a fixed cable which serves as track rail for the loads, (*b*) an endless rope which revolves over two terminal wheels by the gravity of the loads fixed to it by clips, and which brings back the empty carriers. To control the movement of loads in their downward journey, the lower terminal wheel is (or if necessary, both the wheels may be), equipped with brake arrangements. There are at present three ropeways of this type working in the Thandiani range, Lower Hazara North division.

II.—*Gradient.*—The gradients on the existing ropeways are 11°, 13° and 19°. It is believed that the plant can run safely with any gradient from 10 to 25 degrees.

III.—*Length of span.*—The existing spans are 2,200′, 3,060′ and 3,080′ long, and it is believed that the maximum length of the span may be upto 4,000′.

IV.—*Description of component parts.*—

(*a*) *Carrier cable*, which serves as a track rail for the carrier pulleys.

Specification :—Flexible, crucible steel, non-galvanised wire rope 6 x 19 construction 1½′ circumference, ordinary lay.

Average weight per 1,000 feet = 3¼ cwt.
Breaking strain = 6 tons.

It is believed that a better quality of steel and " Laug's lay " instead of " ordinary lay " would be an improvement.

(*b*) *Traction Cable* which revolves over two terminal wheels. The carriers are clipped to this cable, which also brings back empties.

Specification.— Flexible, crucible steel, non-galvanised wire rope 6 x 19 construction, 1 circumference, ordinary lay.

Average weight per 1,000 feet = 1½ cwt.
Breaking strain = 2·8 tons.

(*c*) *Terminal wheels* on which the traction cable revolves

Specification.—Close grained cast iron ; 2′ 6 diameter with a U shaped groove, 1½″ deep, and a brake hand at the level of the groove, brass bushed and fitted with an axle.

(*d*) *Sheaves* used at the upper station to keep the traction cable in position so that the return empties can conveniently be handled at the station platform and do not hit the ground.

Specification.—20″ diameter with a U shaped groove 1″ deep.

(*e*) *Clips* which grip on the traction cable immediately in front of the paired rings, and keep the carriers and loads from sliding.

Specification —Mild steel with notched gripping surface very much like ordinary hand vices.

(*f*) *Carrier Pulleys* which run over the carrier cable and support paired rings with hook.

Specification.— Pulley block made of mild steel fitted with a swan neck hanger of mild steel rod 1″ diameter with the free end pointed and bent up to form a hook.

(g) ***Paired rings with hook.***—The pair of rings to hold the traction cable between them, and the hook to pass into the eyes of the slings by which the load is suspended.

Specification—Rings made of mild steel $\frac{3}{8}''$ thick, and 6″-8″ in diameter, with a sliding hook made of steel rod 1″ diameter.

(h) ***Brake***, which bears directly upon the band of the terminal wheel, and when applied reduces the revolutions of the wheels, thereby controlling motion of the traction cable and the loads fixed to it.

It consists of a block of wood shaped to the form of the band of the wheel, the block being fixed on a piece of strap iron $\frac{3}{8}''$ thick, bent into the same shape by first doubling and then splaying the ends to necessary curvature, leaving nearly a foot of doubled length as a tail. Into the end of the doubled length is riveted the screw end of a rod, the screw portion of which passes through a fixed iron bolt with the internal surface struck with a corresponding screw thread. The other end of the rod is provided with a handle by the cork screw motion of which the bearing block of wood can be advanced or retracted according to requirements. In Hazara *Celtis australis* timber has been used for wooden blocks and has proved very satisfactory.

(i) ***Anchor***—To anchor the carrier cable. The usual type of anchor consists of a horizontal log 9′-10′ long and nearly 4′ girth, with two strong vertical posts pressing against it fixed firmly in the ground. The rope is given at least three turns round the horizontal log and the free end then tied round a tree or stump. In Hazara *Quercus dilatata* wood has been used for anchor posts and has been found satisfactory.

V. *Erection*—

(a) ***Choice of line.***—Choose a line clear of obstacles between the stations. In judging obstacles for a span of 3,000 feet, give below the bee-line between the stations an approximate clearance of 150′ at the centre, of 75′ at the quarter distance of the span and so on. Avoid a flat stretch of any length, almost at the same level with and in front of the station.

(b) ***Terminal wheels.***—Fix firmly in the ground two strong vertical posts about 12′ long, 1′ 6″ apart and facing truly

corresponding posts at the other station. The posts should be bedded at least 3 to 4 feet into the ground and well strutted. Notch the vertical post on the upper side horizontally, for convenience at 4 to 5 feet above the ground. In case of gradient of the rope being steep enough to necessitate brake arrangements at the upper station, fix the wheel as low as possible to permit of the application of the brake by the brakesman from a sitting position. Place the axle of the wheel in the notches and finish off by fixing pieces of strap iron or wooden cleats to hold the axle in position inside the notches.

(c) To fix sheaves.—Follow arrangements described for fixing the wheels. Fix lower sheave so as to provide a clearance of 8 to 10 feet above ground for the lower side of the traction cable. Fix upper sheave so as to keep upper side of the traction cable within an easy reach of the workman's arm to facilitate the suspension of loads and application of clip.

(d) The working platform.—This is a wooden platform made of planks supported on horizontal and vertical posts. For the upper station, keep the upper end of the platform well below the lower side of the traction cable to facilitate detachment of empty carriers. Slope the platform gently to keep it well below the upper side of the traction cable.

(e) To make collapsible loading platform.—This is built towards the lower end of the working platform, in between the upper and the lower side of the traction cable. Place lengthwise a 12 feet plank below and parallel to the upper side of the traction cable towards the sloping end of the platform. Hinge it at the upper end, on one of the horizontal posts of the sheaves trestle. Hinge a piece of wood of suitable length on another horizontal post immediately below the lower end of the plank. To lift the plank raise the prop which supports it from underneath and brings it into horizontal position. To lower the plank drop the prop by the stroke of a wooden stick.

VI. *-Loads, speed and capacity.*—

(*a*) *Load.*—Safe working load is 1/6th of the breaking strain of the carrier cable. For the $1\frac{1}{2}''$ circumference rope used

on the existing plants, safe working load is one ton, being 1/6th of the breaking strain which is 6 tons. In actual practice, two loads of 10 c.ft each at the maximum are on the line at a time. The total load on the line is, therefore, as under :—

20 c.ft. @ 25 seers per c.ft. = $12\frac{1}{2}$ maunds.

4 carrier pulleys with rings

@ 1 maund each ... = 4 ,,

Total .. = $16\frac{1}{2}$,, or ·57 tons.

The load capacity of the plant is, therefore, probably higher than two loads of 10 c.ft each, although loads heavier than this have not been tried in Hazara. Also remember that stresses due to loads on incline increase with the inclination of the rope. Thus stresses on rope due to a load of the 20 c.ft. are greater when the rope inclination is 20° than when it is 12° as shown in the following table. These stresses are met by the tensile quality of the rope. Therefore, loads being equal, the greater the inclination, the less tight the rope should be, to provide more elasticity in the rope. This table gives the value of stresses against angles of inclination with a constant allowance for rolling friction at 15 lbs. per ton of the load including the weight of the rope.

Angle.	Strain lbs.	Angle.	Strain lbs.
2—52	127	19—18	697
5—43	239	21—49	847
8—32	348	24—14	935
11—19	448	26—34	1,016
14—3	560	28—49	1,095
16—42	658	30—58	1,167

(*b*) *Speed.*—The speed varies with the inclination of the rope, being 750—1,000 feet per minute on the average on the existing plants.

(*c*) *Capacity.* – The average daily capacity is 1,000 c.ft. on the basis of a 7 hour day with 15 loads of 10 c.ft. each to an hour.

VII. – *Method of Working.*—

(*a*) *Loading.*—Place the timber to be loaded lengthwise on the raised collapsible plank. Apply a clip on the traction cable in front of the load. Place the carrier pulley on the carrier cable above the front end of the load. Clasp the upper side of the traction cable behind the clip in between the paired rings and pass into them the hook of the carrier pulley. Pass the sling below the timber on the collapsible plank and put the eyes of the sling into the hook of the paired rings. Follow the same procedure with regard to the rear carrier pulley for fixing the back end of the load. Lower the collapsible plank, this will leave the load suspended on the line. It then needs only the release of the brake to proceed on its downward journey.

(*b*) *Timing.*—Begin by fixing a load at the upper station and empty carriers at the lower station. Open the brake so as to start the load. When the loads and empty carriers are opposite each other, apply brake. Proceed again in the same manner, fixing load at the upper and empty carriers at the lower station. This gives correct timing.

(*c*) *Braking.*—Always apply brake gradually. Find out points in the journey of the load when braking should commence. The position of these points will naturally depend upon the gradient and the sag of the rope.

VIII. – *Working costs.*—

In Lower Hazara North division the working costs are as under :—

Upper Section.

		Rs.	a	p.
2 coolies for loading @ As. 14 per day	...	1	12	0
1 coolie for detaching empties @ As. 14	...	0	14	0
2 coolies for carrying timber from timber stacks to the platform @ As. 10 per day	...	1	4	0
Carried over	...	3	14	0

Lower Section.

		Rs.	a.	p.
Brought forward	...	3	14	0
2 coolies for unloading @ As. 14 per day	...	1	12	0
1 coolie for tying empty carriers @ As. 14	...	0	14	0
General.—1 *mistri* @ Re. 1-10-0 per day	...	1	10	0
Total	...	8	2	0

Rs. 8-2-0 per 1,000 c.ft. or 1·6 pies per c.ft.

The wages of ropeway coolies and mistri differ with the locality, but it is hoped that working costs would rarely exceed 2 pies per c.ft.

IX.—*Cost of material, weight and where available.*—

Name of material.	Cost.				Where available.
	Rs.	a.	p.		
1. 1¼" Rope ...	23	0	0	per % feet.	Messrs. W. Crowder & Co., Karachi
2. 1" Rope ...	17	8	0	„	Ditto.
3. Terminal wheels	40	0	0	each	Made to order at the Railway Workshop, Rawalpindi.
4. Sheaves ...	5	0	0	„ ...	Patriata Ropeway, discarded sheaves.
5. Carrier pulleys	12	0	0	„ ..	Made to order at the Railway Workshop.
6. Clips ...	10	0	0	„ ..	Ditto. Can also be prepared locally @ Rs. 8 per clip.
7. Brake ..	10	0	0	...	Made locally.

X.—*Estimate of cost of material and erection charges for a 3,000 feet span.*—

		Rs.
1¼" rope 3,500' @ Rs. 23 per cent. ...	...	805
1" rope 7,000' @ „ 17-8-0 „ ...	...	1,225
2 Wheels @ Rs. 40 each .	.	80
Carried over	.	2,110

			Rs.
	Brought forward	...	2,110
2	Sheaves @ Rs. 5 each ...	...	10
8	Pulleys with carriers @ Rs. 12 each	..	96
4	Clips @ Rs. 10 each	...	40
1	Brake @ Rs. 10 each ...	.	10
	Total	...	2,266

XI.—*Erection charges.*—

Rs. 200 at the maximum.

I. D. MAHENDRU,
Divisional Forest Officer,
Lower Hazara, North Division.

THE PALMS OF BRITISH INDIA AND CEYLON

By Rev. E. Blatter, (Oxford University Press, Bombay, Price Rs. 30.)

During the period 1910—1918 a series of papers by the Rev. E. Blatter, S. J. Ph.D., on the Palms of British India and

Ceylon appeared in the Journal of the Bombay Natural History Society. These have now been collected and republished in book form by the Oxford University Press, Bombay. It is unfortunate that the illustrations which form the most useful part of the book to the general reader have lost somewhat in reproduction compared with the originals in the Bombay Natural History Society Journal. They have been bound in such a way that in some of them it is difficult to see the explanatory print beneath the illustration. The book would be greatly improved if some key to species had been attempted in the case of genera in which several species have been described. In the case of Sabal for example in which many of the species are in cultivation a translation of Beccaris key to the species from "Webbia" would have been interesting as Webbia is a publication not readily consulted in India. Whether the key would be found satisfactory or not is of course another question but in the book as it stands at present much time is apt to be lost in wading through long descriptions of details which do not assist in determining the species. In the case of closely allied forms such as *Hyphaene thebaica* and *H. indica* or *Trachycarpus excelsus* and *T. takil* it would have been better to stress the points of difference rather than to obscure them in a long description applicable to either species.

The map on page xviii showing the distribution of palms is inaccurate in several details. Palms occur in the very centre of Australia and in the S.-E. corner (Gippsland), also in the South Island of New Zealand and in the S.-E. corner of the United States all of which areas are excluded from the region of palms as shown in the map.

The book is more than a reprint of the original series of articles as it has been revised and amended in several places. For example the genus Borassus instead of being regarded as monotypic is now, following Martelli, considered to include seven species. Under this arrangement *B flabellifer*, Linn. is regarded as being indigenous to India and *B. sundaica* indigenous to the Malay Archipelago. As this view is so different to the one hitherto adopted it would have been useful had the author given

the public an abstract of Martelli's reasons for considering the tree cultivated in India different from the African form, and also the opportunity of being able to decide whether the Borassus cultivated in Burma is *B. flabellifer* or *B. sundaica*.

The general plan of the book is excellent and the idea of illustrating each species by a photograph of the living plant is admirable since to the general reader a photograph of a palm is likely to convey a far better idea than the most detailed description. It is to be hoped that some day it may be possible to write a book of this nature from a more local point of view. For example over two pages are given on the cultivation of *Jubaea spectabilis* in Europe but there is no indication of its being cultivated in India. It is included in the list of palms grown in Peradeniya in 1888 and has been grown in Lahore for the past ten years or more. Even in the case of a commonly cultivated species such as *Rhapis flabelliformis* we are told that it is adapted to room-cultivation in Europe but nothing at all is said about its cultivation in India. R. N. P.

A SHIKARI'S POCKET BOOK.

(BY CHARLES McCANN AND LT.-COL. C. H. STOCKLEY, OXFORD UNIVERSITY PRESS, BOMBAY, PRICE Rs. 5.)

"I have met sportsmen... .....who, having expended much money on their expeditions, utterly failed to preserve their hard-earned trophies for want of easily acquired knowledge and methods." This extract from the foreword of this little book is the justification for its publication. It is not a shikar book but tells the sportsman what to do from the moment when he has killed his game. The first 48 pages contain the text divided into five sections dealing respectively with masks, entire specimens of big game, small mammals and birds, butterflies, equipment. The technique of skinning is carefully explained with the aid of clear diagrams, and instructions are given on measurements and the special treatment of skulls and teeth The skinning out of the difficult parts, ears, lips, nose and feet is exhaustively dealt with

and also the use of preservatives both for dry and damp climates. No young shikari who follows these instructions should experience the mortification of seeing his first tiger skin spoilt because the ears or toes have putrified. The native shikari and the inexperienced sportsman rarely know how to make the cuts for skinning the hind legs of a tiger; the correct method is explained but we should prefer to see the peculiar form of the correct cut more strongly emphasized both in the text and in the accompanying diagram. We note also the omission of instructions for the treatment of muggar skins. The second part of the book consists of a refillable notebook with sections ruled off as a big game register, collector's field book and plain note book. We failed to find any instructions for obtaining refills. There is a pocket for papers and a good quality pencil. The stout leather binding with protective flap looks capable of resisting the general knocking about in a shikari's pocket and what is even more important, the effects of perspiration on it Altogether a very useful little book which fills an obvious gap.

EXTRACTS.

FOREST DESTRUCTION AND ITS EFFECTS.

The question of the effects of forests on rainfall has been debated by foresters, agriculturists, engineers, and others for a long period the discussion probably dating back to the time at which scientific forest conservancy was first introduced. In the tropical and sub-tropical parts of the world this is not, however, the point of primary importance. The vital factor for the community at large is the determination of how far the destruction of forests in catchment areas and on the sides of hills and mountains in the drier parts of a country affects, in the first place, the level of the water in the big rivers, a matter of extreme importance when the rivers are utilised for irrigation or power works; secondly, the decrease in the local water supplies and in the local precipitations upon which the cultivator is dependent, and thirdly, erosion and avalanches, and the destruction they cause in the fertile valleys beneath Sudden floods may

also cause enormous damage to railways, towns, and so forth. In India, which was the first part of the British Empire to give consideration to this aspect of the forest question, the matter has been the subject of discussion and reports through the whole of the past century, a statement which will perhaps come as a surprise to many in Great Britain.

The problem of affording protection to forests for the above causes alone is by no means new. In France and Germany special laws for the protection and extension of the forests and the protection of agricultural lands by means of the forest have long been in operation; and similar laws exist in the Italian States. So far back as 1475 the subject attracted the attention of the famous Venetian Council of X., by whom a law was passed on January 7th of that year, regulating in great detail the clearance of the forests on *terra firma*. The mountain forests especially were protected by judicious regulations, which were renewed from time to time down to the very year of the extinction of the old republics. Tuscany and the Pontifical Governments were equally provident.

History has since shown that the wholesale destruction of forests in Spain, Italy, Sicily, Greece and Macedonia has resulted in a great deterioration of climate over considerable tracts, due to loss of moisture, the sterilisation of the soil, and excessive erosion.

Although now well known, the chief action of the forest may be briefly stated as follows: –

The great factor in mountainous and hilly country is the maintenance of tree growth on parts of the area. In the case of bare slopes the rain rushes rapidly down, causing erosion, only a fraction percolating into the soil, and is carried rapidly away, giving rise to spates and perhaps to serious floods, since the old channels of these streams or rivers are no longer able to carry the excess water of flood levels. A hot sun bursting out on to the slope after the rain quickly dries up the thin layer of moisture covering it. In the hotter parts of the globe subject to heavy rainstorms or monsoons the rushing water starts

gullies [which eventually become ravines, all surface soil is rapidly washed away, and in the course of years the hillside is eaten into, rubble and boulders being sent down to cover up valuable lands below. When the area is under trees, a portion of the rain, falling on the crowns, drips slowly down on to the layer of humus beneath and sinks into it. The larger portion perhaps falls direct on to the forest floor; where it is gradually absorbed in the soft covering which takes it up as a sponge. The water then percolates slowly downwards, filling up springs and underground reservoirs, and reaches the streams in a retarded manner. The flow in the latter is consequently more even and regulated, as also the amount of water which eventually reaches the rivers. *The latter can, therefore, be more depended upon* to maintain a normal level when it is required to utilise them for irrigation or power works. The roots of trees protect the surface by holding up the soil, and thus directly prevent denudation.

It is possible to give some concrete examples of the effects of the destruction of teak forests in India during the first half of last century, owing to the large demands for this timber from rapidly expanding markets

The slopes on the west coast of the Bombay Presidency were once, even in the early days of British occupation, covered with magnificent, valuable, and extensive teak forests. These have long since been cut out, some disappearing for good. The denudation of the Deccan Highlands and the Eastern Ghats has resulted in excessive erosion and the gradual silting up of the rivers. When the Dutch, French, and English first built settlements on the Coromandel Coast, it was possible to take ships up the Godaveri and Kistna. The English port of Narasapur and the French one of Yunaon, both on the Godaveri, were once the chief ports on this coast. They can now be reached only at high tide by small native shallow draught craft. Last year the present writer had arranged to go down the Godaveri from Sironcha, on the frontier of South Chanda (Central Provinces) and the Hyderabad State, to Rajamundri, as he wished to carry out investigations in connection with the effects

of forest denudation on this river. It was early in March, the commencement of the hot weather season only. Inquiries elicited the fact that few rafts were now going down, owing to the extensive sandbanks already drying off in the river, and that even by dugout canoe, delays from stranding on sandbanks would be inevitable. Some hundred years ago this great river was the chief artery or high road into the interior! At Masulipatam, Dutch ships used to ride at anchor close up to the port, whereas at the present day even small native vessels have to anchor five miles out in the roads owing to the silting up. Between 1840 and 1850 Dr. Gibson, the first Conservator of Forests in Bombay, drew up a list of the rivers and creeks on the Malabar coast, where on arrival in those parts ships used to ride at anchor, all the creeks having silted up within the memory of men then alive.

Dr. Cleghorn, who afterwards became the first Conservator of Forests in Madras, directed attention to the destruction of tropical forests at the meeting of the British Association in Edinburgh in 1850. A committee was appointed to consider this matter. Dr Cleghorn submitted its report, which was confined to India the only country for which information was available, at the meeting of the Association at Ipswich the following year. The report summarised the position, as then known to the few in India who had given attention to the matter, pointing to the great and uncontrolled destruction which was taking place, both at the hands of timber merchants and owing to the careless habits of the native populations who grazed their cattle at will in the forests and fired them every year in order to encourage the growth of new grass. The indigenous tribes in the hilly country also practiced unchecked shifting cultivation, a practice second only to the lumberer in the destruction of fine forests. Under this method, which was a common habit in Europe in olden times, a patch of good forest is felled and the material burnt *in situ*; coarse grains are then sown on the clearing. The cultivator then sits down and then awaits the harvest. Two or three crops are taken off the area; the weeds then become too strong (as he never troubles to weed)

and he moves on to a fresh area. The enormous destruction of virgin forest this practice entails, when practised for centuries, has to be seen to be credited. Yet many of the tropical and sub-tropical forests in British Colonies and Dependencies are still subject to this most pernicious and precarious form of so-called agriculture (as also to over-grazing and firing), the administrations responsible not having yet, apparently, understood the evils which attend it. The difficulties facing these Governments in prohibiting the practice, or controlling it, were all experienced in India in one form or another, and overcome.

The encouragement given to the growth of tea and coffee and similar crops by British administrations in the Empire *whilst eminently praiseworthy* if carried out on well-considered lines, has been productive of great harm in the past, and even the present day can scarcely be said to be free from anxiety on this score. In a report written in India in 1876 reference to coffee planting, the following criticism is made :—

"The planters who come over from Ceylon are now giving a very high price for land, and the whole mischief may be effected in a very short time. It must not be supposed that coffee is at *all a permanent cultivation ; we have only to look at the Sampajee* Ghat in Coorg, the Sispara Ghat in the Nilgiris, and parts of the Annamalais to see at once that it is very often very little better than the shifting cultivation of the natives. It pays a coffee planter to take up a tract of primeval moist forest on our mountain slopes for a few years, he gets bumper crops the third, fourth and fifth years, but denudation of the soil and erosion goes on rapidly, and it does not pay him to keep it up many years."

Two other examples *may be mentioned. In Ajmer-Merwara* in Rajputana, all the waste and forest land was handed over to the people by Government in 1850. The hills were rapidly denuded of timber and grazing was uncontrolled. The crops are irrigated from tanks (ponds) formed by building embankments across ravines. Some of these were very old. The rainfall is scanty and comes in heavy showers. The water rushing down in torrents, quickly eroded the denuded hillsides, the tanks filled up with silt and debris or the enbankments burst. In 1869, at the

end of a two-year famine, the region was described as follows:— "The cattle had perished, the people had fled, large villages were entirely deserted and the country was almost depopulated." All this was due to the mistaken policy of giving to the people what they had clamoured for, the uncontrolled use of forest lands. An even more classic example is that of the well-known Hoshiarpur *Chos* in the Punjab. The hills were formerly fairly well wooded A rapid increase in population followed the advent of British administration in 1846. The consumption of forest produce augmented, the herds of grazing cattle multiplied excessively and complete denudation ensued. This was followed by erosion, broad stretches of sand invading the plains beneath, with the result that the arable lands of 940 once prosperous villages were covered with sand, which laid waste upwards of 70,000 acres of fertile lands. In 1900 this formerly rich district was traversed by numerous broad, parallel, sandy belts cut out of the crop-bearing and fertile area.

In India these matters are now well understood, and the Forest department, supported by the Government, has control of the great forest areas. Proofs of the disadvantages and disasters following the uncontrolled wasteful utilisation of the forests in mountainous and hilly country are not, therefore, wanting. It is known that the same processes are at work, and the same mistakes are being made in our Colonies. It is the habit of British administration to work in watertight compartments. Probably the major portion of the difficulties being experienced in different parts of the Empire have been solved, or are approaching solution, in one or the other provinces in India. They present no new features as some appear to think, as the above quoted examples go to prove. The chief difficulty is that action is delayed until almost irretrievable damage has been done and then the forester is asked to reafforest the areas so denuded. This entails an enormous expenditure, great skill, with success ever hanging in the balance.

Attention was directed to this subject at the meeting of the British Association in Edinburgh in 1920, when a paper dealing with the Indian forests was read. Resolutions of the same kind

were also passed by the World's Forestry Congress held at Rome in May 1926. As an outcome of last year's meeting of the British Association at Oxford, the chairman of the Forestry Sub-section, Lord Clinton, drew up for the Council a brief statement dealing with the destruction of the forests on hill slopes, with special reference to the tropical forests of the Empire. This memorandum has been submitted to the Secretary of State for the Colonies, by whom it is being communicated to the Colonies and Protectorates. It may be hoped, therefore, that the chief factors of destruction, namely, shifting cultivation, excessive grazing and the firing of forest lands, may receive that measure of considered control which the expert forestry services under the Colonial Office are fully capable of inaugurating if supported by the several administrations. —(*Nature, Vol 119 No. 2984*)

FORESTRY—(LORD LOVAT ON WORK OF THE COMMISSION)

Lord Lovat, the chairman of the Forestry Commission, an office which he is shortly resigning, was present yesterday at the annual meeting in Edinburgh of the Royal Scottish Arboricultural Society. In the course of an address Lord Lovat spoke of the census of woodlands which had just been completed, of the investigations into the question of peat, and the collection of data relating to damage done by the recent gales on which the Forestry Commission was engaged.

Sir Hugh Shaw-Stewart, Bt, C.B, in his presidential address, spoke of the past and the future of forestry.

Lord Lovat said that the first ten years' experimental period in forestry looked to be going through on the lines originally planned. He felt that the first thing to do in order to make up the nation's mind for the second period was to be able to tell them not by guesswork, but actually what was the amount of timber that we had to rely on in the case of any emergency. Accordingly they had carried out a census of woodlands. It had taken nearly five years, and the figures would very shortly be ready for publication. He regarded this as one of the most

important works they had done, because it was going to form a record to which subsequent reference would be made, and people would know in the future what was their position as a timber-producing nation He was sure that when they saw these figures they would be surprised at the areas of timber that were cut down and had not been replanted at the proportion of what he might call uneconomical wood out of the three million acres which existed, and at the small area of mature conifers which existed in Great Britain.

The second point on which he desired to say a word was a question which interested them specially in Scotland, particularly in the Highlands—the question of peat investigation. They were having the question investigated on the laboratory side under Professor Borthwick at Aberdeen They were taking full advantage of the important investigations done by private enterprise, notably the work done by Sir John Stirling-Maxwell at Corrour and by the Duke of Buccleuch at Muirburnhead. The scientific staff was continually in touch with these two centres, and there was no question that these two enlightened proprietors had saved the Commission many years' work, of which they were now just getting the results, both negative and positive. The research staff were carrying out a series of investigations. One of the centres was at Loch Ness, from which they radiated through the length and breadth of the land. He believed that in a year's time from now they would be able to give them some important information on the subject and he believed they could look hopefully to treating successfully a good many types of peat not treated successfully in the past.

DAMAGE BY THE GALE.

The final point he wished to discuss was an unfortunate one. They had suffered throughout Scotland and through the north of England very largely from the recent gale, and he was sure they were all agreed that it was important that they should put upon record as much as possible all that was known about this gale and its results, how it struck various types of plantations. Accordingly they had instructed their statistical officer to get

into touch with the Consultative Committee, both in England and in Scotland, in order to get all the facts which they thought would be valuable—questions of saturation of soil, exposure, of the species which offered the most and the least resistance to the gale, the question of space in planting, shelter belts, and questions of damage, and generally any other facts which might be of use to them in showing what resistance could be offered to such gales. He thought this would constitute really important work, because, although they could not make good the damage done by the gale, they might at all events gain something effective which might give them information which would lead to less damage being done in the future. In conclusion Lord Lovat said that he could assure them that one of the things he should treasure most when he gave up the post of chairman of the Forestry Commission was the support which he had had from their Society.

PRESIDENTIAL ADDRESS.

Sir Hugh Shaw-Stewart, in his presidential address, which he entitled "British Forestry—Some Deductions from the Past and some Hopes for the Future," said they did not need to go far back for a forestry retrospect No attempt at forestry, as we understood it to-day, was made till the first quarter of the eighteenth century. In 1738 the second Duke of Athol began the extensive plantings of the Continental larch tree. Sir Hugh quoted from the Transactions of the Highland Society in 1820 to show how extravagant were the expectations of forestry prevailing little more than 100 years ago. In the failure of such sanguine hopes they might find some explanation for the neglect of forestry by their immediate predecessors. During this period of general neglect by landowners there were some brilliant exceptions. In the latter part of the nineteenth century young proprietors like Munro Ferguson (now Viscount Novar) studied Continental methods, and devoted much of their energy and skill to the practice of these methods at home on a considerable scale. Had it been possible in those days to introduce the new trees in such quantities as to plant them in forest formation, or at any rate in

groups, they should much earlier have learned lessons that they were only now beginning to apprehend.

Wider Spacing.

This fashion of planting trees in isolation had led many planters to wrong conclusions. One, derived from arboretum planting, had been the fallacy that in order to prevent undue spread of branches they should rush to the other extreme, and irrespective of the rapidity of growth which was so characteristic of many new kinds, they should crowd them in the densest formation. This wrong conclusion (as he believed it to be) received a great impetus from a remarkable little book published in 1900 called " The New Forestry," by John Simpson. Sir Hugh spoke of a recent visit to the woods at Stour head, on the borders of Wiltshire and Somerset, and produced a table showing the results of planting respectively eight feet and four feet apart. Even after allowing for three years difference in age, the trees in the wider planting showed not only greater height, growth, and greater stem diameter, but in spite of less than half the number of stems per acre a greater volume of timber.

The Forestry Commission.

Proceeding, Sir Hugh referred to the Forestry Commission, a child, he said, that had only passed its seventh birthday, but a prodigious infant. The work it had accomplished in a few years had already made a great mark in the forest history of the twentieth century. An explanation of its success would seem to arise from the composition of the body of Commissioners, and especially from the personality of the first chairman, Lord Lovat, who had such a capacity for inspiring enthusiasm in those who worked with and under him.

Before closing, he would like to consider how they could remove the apprehensions of some landowners who hesitated to replant areas felled during the war or in the ordinary course of estate management. They sometimes heard it said —the future is so uncertain the property may have to be sold ; in any case planting is an expensive operation. Well, the obvious answer to

that proposition was that an area of land properly planted contained a far higher prospective value than such land left derelict and waste.

DEATH DUTIES AND PLANTING.

Another deterrent to some owners was the fear of prospective death duties. Heavy as this tax was on all property liable to such duty, there were some features as regards timber crops not always fully apprehended. No land under growing timber (young or old) could be included in the aggregate of a property for valuation for death duty unless the owner so wished. Therefore, the more the land in woodlands or plantations, the less was the total acreage of the estate aggregated for valuation. A tree became liable for death duty only when it was sold, and —this, he believed, was not as generally known as it might be—trees used for estate purposes were not liable. Further, where the sales of timber in any year amounted to "less than all necessary outgoings," there could be no liability for death duty Charges admitted were valuation roll rental of woodlands, occupiers' rates and taxes on woodlands, maintenance of plantation fences and drains, and management charges of woodlands. Young plantations not measurable at the date of succession did not apparently come into the valuation of timber made at the succession. In practice, the incidence of death duties only fell heavily on an estate in a case where the heir chose to make a heavy felling in order to pay the death duty or for some other special purpose.

He hoped that these considerations, verified with some care with the ready aid of their new vice-president, Mr. Milne Home might remove some apprehensions from the minds of would-be but hesitating planters.

A discussion followed.

At the close of the meeting Dr A. W. Borthwick, Professor of Forestry in Aberdeen University, and honorary editor of the Transactions, was presented with a writing-table and chair made from Scots-grown laburnum, in recognition of his work as honorary editor for 15 years. Tributes were paid to Dr. Borthwick's work

by the chairman, Sir John Stirling-Maxwell, Bt.; Mr. Robinson, of the technical staff of the Commission; and Mr. J. D. Sutherland, Assistant Forestry Commissioner for Scotland.—(*Glasgow Herald.*)

AIR-SURVEY IN THE IRRAWADDY DELTA.

A recent publication of the Survey of India deals with the survey from the air which was undertaken at the instance of the Burma Forest Department for the purpose of providing large scale topographical maps of the reserved forests of the Delta Forest division and of preparing forest stock maps by the interpretation of the forest growth from the photographs. The country concerned consists of densely-wooded alluvial plains, forming part of the coastal area of the Irrawaddy Delta. It is divided into six main areas by branches of the river and each section is intersected by innumerable tidal creeks. The average height of the ground is about 2 feet above ordinary high tides, which flood part of the tract, while at high spring tides a very large proportion of the whole country is submerged. Communications within the reserves are entirely by water; progress by land is most laborious, if not impossible, especially in the lower-lying parts where the ground is covered by roots which imprison the foot at every step. Except on the sea-face where there are sandy beaches, the banks of creeks which are covered at high water consist of soft mud, into which a man is liable to sink waist deep. Such a tract might be deemed uninhabitable; but as the saying goes, half the world does not know how the other half lives. There are many villages in the area, whose inhabitants, engaged in the fishing industry, appear to be happy and contented, and the reservation of the forests alone prevents the whole tract from being cleared and used for rice cultivation.

It would be difficult to find a tract of country more suitable for survey by air photography or more difficult to survey on the ground. The advantages of the former method are, the country is flat, it is broken up into convenient sections by broad streams, each section contains conspicuous features in the form of

creeks which assist the aviator in "stripping," a sea-plane can alight anywhere in case of necessity, and there is practically no topographical detail which needs to be identified on the ground. The few disadvantages are that minor creeks up to 5 yards wide are frequently obscured by over-hanging trees and cannot be traced throughout their full length; and it was seldom found possible to photograph the coast line at low tide but this was not of great importance as the sand-banks are constantly shifting. A ground survey on the other hand would be very troublesome, hundreds of miles of theodolite traversing along the larger creeks would be required, and where subtense methods are impossible, chaining through dense jungle would have to be done. For the smaller creeks, plane table traverse from boats would have to be carried out. It was estimated that a ground survey by a party of normal strength, thirty surveyors, would have taken from three to four years, and have cost about Rs. 500 per square mile. Even then it would compare most unfavourably with air survey as regards accuracy of local detail and might not be superior in accuracy of position. The total area photographed by the air survey was 1,440 square miles, and the cost was Rs. 273.7 per square mile. The cost of the photography alone was Rs. 210.4 per square mile, and it was high as this single project had to bear the whole of the initial expense of the organisation.

The various operations of this air survey are described in the report by Major C. G. Lewis, R.E. In the matter of the ground control, there was some difficulty at first in fixing points in the area to be surveyed. But when it was found that the sea-face consisted of broad sandy beaches where accurate traversing was easy, and that a portion of it was visible from two of the stations of the coast triangulation series, the procedure caused no further trouble, and, carried out, it proved to be accurate and rapid. The air photography was commenced in February 1924 and completed in the following April. The cameras used were of the L. B. type, and the total number of plates exposed was 3,795. The average height maintained throughout was about 9,400 feet, resulting in a scale of about 3·4 inches to the mile,

This scale is about the smallest compatible with the proper interpretation of detai The preparation of the mosaic occupied the time from the end of April to the end of August, about four months, and it is said that the time was long as the men employed were untrained. The scale of the fair-mapping was 3 inches to the mile. The report mentions that the formation of accretions is constantly taking place along the sea-face of the Delta. The successive coast lines are well shown up in the photographs throughout the grass lands bordering the shore. There are sandy hooks in various stages of formation, while, elsewhere, generally midway between the mouths of rivers, erosion is taking place, as evidenced by the forests of dead trees standing out in the sea at high tide. Future photography of the coast line will provide interesting data for the study of the formation of accretions The Delta air-survey was altogether a valuable and successful piece of work.—(*Indian Engineering*, *19th March* 1927.)

TEREDO *(KUPHUS ARENARIOUS)*.

At the Genera Meeting of the Linnean Society of London held on 16th December 1926 Dr. W. T. Calman exhibited a specimen of the Giant Teredo.

The Giant Teredo, *Kuphus arenarius* (Linn.), first described by Rumphius two hundred years ago, has hitherto been known chiefly by its massive shelly tube, which may be as much as four feet in length and three inches in diameter at the wider end The specimen exhibited is believed to be the first example of the soft parts examined by any naturalist. It was collected by Captain Burgess, of the Mission steamer 'Southern Cross, in the Solomon Islands and forwarded by Mr. D. Holderness, Harbour Engineer, Auckland, N.Z., to the Sea Action Committee of the Institution of Civil Engineers. It comprises some thirteen inches of the posterior end of the body, with the siphons and pallets. Instead of boring in wood like the other Teredinidæ *Kuphus* lives embedded in the mud of mangrove-swamps, with the siphons projecting from the surface. The valves of the shell have never been seen in full-grown examples, and it is

possible that they disappear in course of growth. There are some indication that the mud-living *Kuphus arenarius* may be the full-grown condition of a timber-boring species (perhaps *Teredo mannii*) which is set free by the decay of the wood. If this be the case, however, it is somewhat of a mystery how the animal maintains its position in the mud, for the sucker-like foot of the Teredinidæ seems ill-fitted for locomotion in these conditions.

In the discussion that followed, Mr. R. H. Burne mentioned the specimens of the Giant Teredo in the Museum of the Royal College of Surgeons, which were found in 1797 in mud stated to have been hard.

Professor E. W. MacBride said that the Teredo described by Dr. Calman afforded a valuable instance of how new species were formed. This Teredo, beginning its life under normal conditions, finds itself, by the disappearance of the wood, in quite new circumstances, under which, however, it can get abundance of food, as witnessed by the extraordinary size. Under such circumstances animals do not succumb, but adapt themselves and grow enormously. As another example of this, Professor MacBride mentioned a case that had come under his observation, in which some beetle larvæ accidentally introduced into a child's alimentary canal grew to a size far exceeding the normal.

Dr. G. P. Bidder suggested that if the habitat of this Teredo should be in an area of alluvial deposit, the erect position might be maintained merely by upward growth as the mud was deposited over the mangrove roots. The change from boring habit and small size to non-boring life and large size afforded an interesting parallel with the boring sponge *Cliona*, the adult form of which is the massive *Raphyrus griffithsii*. A similar metamorphosis occurs probably, according to Vosmaer, in Neptune's Cup and many allied sponges.

In reply, Dr. Calman pointed out that the direction of growth of the Teredo tube was downwards, addition is taking place at the wider anterior end. [*Proceedings of the Linnean Society of London.*]

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HILL FROSTS AND SAL REGENERATION IN THE UNITED PROVINCES.

In my article "Hill frosts and plains frosts in the United Provinces and their respective effects on sal" which appeared in the *Indian Forester* for December 1926, I attributed the cause of hill frosts mainly to a current of cold air arrested in its downward course towards the plains I tried to show in this article that the cold air completely envelops the trees of the forest and I came to the conclusion that "the tops of the tallest trees will be subject to as great or nearly as great a degree of cold as the seedlings on the ground and consequently damage will be just as great in the crowns of the larger trees as amongst young plants and saplings." This statement was intended to emphasise the difference between the effects of hill and plains frosts, since in the latter case the damage is normally greatest in close proximity to the ground surface. I gave it as my opinion that the periodic (as opposed to annual) nature of the frosts in the hills would be sufficient to account for the fact that sal regeneration in such tracts had no difficulty in establishing itself. Finally I said that "when a frost year does occur leading shoots throughout the forest will be cut back and, moreover, the protection afforded by the shelter of a neighbouring tree will, in the worst frost areas, be insufficient to save the growth beneath from a similar fate."

This year Mr. Makins has been preparing a working plan for the Kalagarh division, where the effects of hill frosts are perhaps more marked than in any other division in the province. Some of the sal forests are to be worked on a system of con-

version to uniform, and it was soon realised that the theories which I have briefly recapitulated demand certain definite silvicultural treatment. For instance, if it were true that frosts are equally severe on the ground surface and in the crowns of the trees and if it were *also true that in the case of a severe frost a scat*tered shelterwood is insufficient to protect the growth beneath, then there is no justification for keeping a shelterwood over established sal regeneration with the object of protecting the latter from frost. This question became at once a matter of some importance for fellings were to commence in P.B.I immediately, and some of the forests included in this P.B. are subject to severe frost. This, too, did not constitute the entire problem. Even supposing it were admitted that severe frosts, such as occur at intervals of perhaps 10 to 20 years, were of such a nature that there was no justification for leaving a protective shelterwood: what about areas subject only to light frost? Would not a shelterwood be of value here?

To arrive at a correct solution of this problem was the more urgent since, if we failed to reserve a shelterwood and thereby greatly intensified frost damage, such a mistake might never be completely remedied, whilst if we retained a shelterwood unnecessarily this would mean augmenting our silvicultural difficulties, both present and future. By good fortune a severe frost occurred early in January this year and I was thus able to observe its effects under the most favourable conditions. All cases of frost damage which I had previously examined were probably of several years' standing and were thus insufficient to give me all the information I required.

In February 1927 I found that the frosts of the previous month had produced the following results :—

(1) The leaves of sal had turned brown from the level of the stream-bed up to various heights, the maximum range being about 300 feet. There was often of course no frost damage, but where damage had taken place the dividing line between forest in which all the leaves had been killed and forest in which no leaves *had been killed was sharp, and a difference of* 100 feet in elevation was usually quite sufficient to complete the change.

(2) The twigs and leading shoots of trees whose leaves had turned brown were killed back to a point where the diameter exceeded 1 to 1½ inches (this statement is based on an examination of the cambium and requires confirmation when the new shoots are produced.)

(3) Nine-month-old sal seedlings, which are plentiful, and all young sal regeneration with stems up to about two feet high, had in no single instance been damaged by frost even to the smallest degree. This relation was quite independent of whether there was an overwood or not and was apparently unconnected with the presence of grass which, in many parts, consists of dense *Anthistiria gigantea* up to 6 feet high

(4) The crowns of dominant and dominated stems were equally affected. The former afforded no appreciable protection to the latter, whilst variations in the general density of the canopy appeared to have no influence on either the dominant or dominated crowns.

(5) The crowns of suppressed stems had received no appreciable protection even in dense patches of forest, unless the patches were both dense and extended continuously over an area exceeding about one square chain. In the latter case the leaves had remained green up to 30 or 40 feet high and the leading shoots were either untouched or less affected than in the crowns dominating them.

Now, if these observations are correct and prove to be of general application they are, I think, sufficient to show that it would be useless to retain a scattered overwood in P. B. I for the sake of protecting the young regeneration from frost. In areas liable to severe frost nothing short of leaving 90 per cent of the crop on the ground would afford protection of any value, and even then it is only the suppressed, and therefore largely worthless portion of the crop, which would be protected. On the other hand areas liable to light frost constitute narrow belts for which separate silvicultural treatment would probably be impracticable.

The opinions expressed in my previous article now require restating to make it clear that the degree of cold amongst the

crowns of the trees is not merely as great as on the ground, it is actually much greater. I presume the reason for this is that the ground itself remains comparatively warm and the convection currents raise the temperature of the air for a vertical distance of 2 or 3 feet sufficiently to exclude frost. It is also necessary to make it clear that the periodic nature of hill frosts is not the only reason for the ease with which sal regenerates itself in frosty localities; the fact that frosts do not ordinarily take place within a foot or two of the ground surface being an additional reason.

I have stated my views with some conviction, and yet I realise that more observation is necessary before they can be accepted with absolute confidence. I hope that other forest officers with local knowledge will give us the benefit of their experience this year. Such a favourable time as the present, combining as it does the results of a good seed year with severe frost, will seldom recur, but the full effects of the frost will only be accurately known when the new shoots appear.

A. E. OSMASTON, *I.F.S.*

5th April 1927.

MORTALITY OF SPRUCE IN THE JAUNSAR FORESTS, UNITED PROVINCES

(BY R. S. HOLE, C.I.E., I.F.S.)

(1) Happening to be at Deoban, in Jaunsar, in June 1922, I noticed what appeared to be a widespread and serious mortality of spruce (*Picea Morinda*, Link).

The matter had not then been referred to me officially for investigation but the large number of deaths and the fact that such preliminary investigation as I was then able to make revealed the presence in these forests of the notorious pest *Fomes annosus*, as well as indications of what appeared to be the work of *Armillaria mellea* (commonly known, hitherto, in forest literature under the name of *Agaricus melleus*) seemed to me so important that I arranged to visit the area again in the following September-October for the purpose of making a more

detailed examination. In the present paper I have summarized the principal results of this investigation and I have grouped my remarks under five main heads as follows:

(*i*) *Fomes annosus.*

(*ii*) *Armillaria mellea.*

(*iii*) *Sun-scorch.*

(*iv*) *Summary of Chief Results and Suggestions regarding Preventive and Remedial Measures*

(*v*) *Miscellaneous.*

(*i*) *Fomes annosus.*

(2) This fungus appears only to have been reported, hitherto in India on the deodar [see *Indian Forester,* 29 (1903) November, Appendix series] In the present inquiry, sporophores of this species were found three times, once on a dead wind-fallen silver fir (*Abies Pindrow,* Spach.) and twice on spruce (*Picea Morinda,* Link.) The records for silver fir and spruce are, it is believed, new for India.

(3) As regards the chief matter with which this inquiry is concerned, *i.e.* the extensive mortality of spruce, this fungus appeared to be of little or no importance. Sporophores were only found twice on the roots of the spruce, once on the roots of a dead wind-fallen tree and in the other case on the roots of a standing tree, still living but very sickly, which had been seriously damaged by Sun-scorch and insects Signs of the fungus were only seen on two roots of this tree and the fungus was, almost certainly, not the primary disease-causing factor in this case. The insects attacking the roots and stem were kindly identified for me by Dr. Beeson as :—

(*a*) *Crypturgus pusillus,* Gyll.

(*b*) *Polygraphus pini,* Steb.

(*c*) Cerambycid larvæ, possibly *Tetropium oreinum,* Gah.

In his report Dr. Beeson remarked "the bark-beetles are believed to be secondary. There is no evidence to lead one to consider any of the species sent as the primary cause of damage to perfectly healthy trees." The primary damage in the case of

this tree was almost certainly caused by sun scorch which will be dealt with in detail below.

On trees other than those on which the sporophores of this fungus were found, the characteristic signs of the attacks of this species in cortex and wood, *viz.*, small, usually somewhat elongate, white patches or pockets, were not noticed as being anywhere striking or obvious on the trees examined during the present investigation. Its presence in dead trees, however, may have been masked to some extent by the vigorous development of *Armillaria mellea*.

(4) An interesting point in connection with *Fomes annosus* is that in none of the three cases in which its sporophores were seen could any distinct rhizomorphs be discovered in the immediate neighbourhood of the sporophores. In one case, however, that of the dead wind-fallen spruce, at some distance away from the sporophores of *Fomes* on the roots, between the bark and wood of the stem, masses of rhizomorphs and sheets of mycelium were found which seemed to be identical with those of *Armillaria mellea*. It thus seems probable that both *Fomes annosus* and *Armillaria mellea* may be found attacking one and the same tree. It also seems possible that the rhizomorphs found associated with the sporophores of *Fomes annosus* on deodar (*Indian Forester*, 29 (1903) Appendix series) really belonged to *Armillaria mellea* and that *Fomes annosus* does not produce rhizomorphs. This is a point of considerable importance which requires further investigation.

It is interesting to note that Mr. Hiley, who has recently made a detailed study of *Fomes annosus* at Oxford, has apparently never found rhizomorphs produced by it and he suggests that, in the case of the deodar mentioned above, *Armillaria mellea* was working in collaboration with *Fomes annosus*.*

During the present investigation, I have been much struck by the way in which two quite different species of wood-attacking fungi may exist on the same tree in close contact with one another. It seems quite possible, therefore, that sporophores of *Fomes annosus* may sometimes be found growing over and more

* *The Fungal Diseases of the Common Larch*, by W. E. Hiley, Oxford, 1919, p. 87

or less enveloping, for example, the rhizomorphs of *Armillaria mellea*.

From the examination of only one or two isolated cases of this kind, it would obviously be natural and justifiable to draw the provisional conclusion that the rhizomorphs belonged to *Fomes annosus*, in the absence of more extended field observations and culture experiments.*

(5) Specimens of the sporophores of this fungus, both from silver fir and spruce, were sent to Kew and they were all identified as *Fomes annosus*, var *indica*, Wakef, and the same as that which had originally been found on deodar, Miss Wakefield remarking that the fungus "agrees in habit of growth, and also in the characters of spores and hyphæ with the European *Fomes annosus*, but differs in the much smaller and slightly differently coloured pores * * * it is to the eye obviously different from the European form, and should I think have a name."

(*ii*) *Armillaria mellea*.

(6) During my first visit to Deoban, in June 1922, I found on dead spruce trees and stumps of felled trees, sheets of mycelium, rhizomorphs and attacked wood showing fine black lines, all of which were apparently identical with those usually characteristic of *Armillaria mellea*, but I could find no sporophores of this fungus. During my subsequent visit in September-October, however, I found several good specimens of the sporophores in the forest near Bodyar. All the specimens I found were on dead standing spruce trees or on stumps of felled spruce trees and were invariably closely associated with sheets of white mycelium (thicker than that of *Fomes annosus* and often veined) and rhizomorphs running between the bark and wood of the stem. The wood in contact with these, also, showed the characteristic fine black lines. The sporophores were found pushing through the bark, singly or in pairs, from near the base of the tree up to

* In connection with this point, it is interesting to note that, according to Mr. W. R. Fisher, rhizomorphs have also been attributed to *Fomes annosus* by Dr. Mayr, Professor of Forestry, Munich, see Schlich's *Manual of Forestry*, Vol. IV (second edition, 1907), p. 436.

a height of about ten feet from the ground The stalk has a distinct collar and the cap, or pileus, is more or less honey-coloured above with scattered dark scales. The sporophores at the time of my visit, however, were by no means plentiful, those found by me were, as a rule, in damp, shady places and I noticed several dried up and withered specimens. The sporophores are evidently fugacious and are thus very liable to be overlooked. The mycelium and rhizomorphs, on the other hand, are more persistant and are usually easily found. The mycelium is usually seen chiefly in the lower, moister, parts of the stem and in the roots, whereas the rhizomorphs usually occur higher up the stem

I was informed, locally, that the sporophores are produced chiefly in July during periods of heavy rain, especially on fallen dead trees, that they soon dry up and disappear and that they are in local repute as being good to eat. Specimens were submitted to Kew and, in her report of April 16th, 1923, Miss Wakefield identified them as *Armillaria mellea* noting that "the material forwarded has been carefully compared with British specimens of *Armillaria mellea*, both as to sporophores and rhizomorphs. There are some slight differences, as for instance in colour and size of surface cells, but they are such as might occur between individuals, and there are none which seem worthy of specific or varietal rank." I am indebted to Dr. E. J. Butler of the Imperial Bureau of Mycology for the information that this is the first record of *Armillaria mellea* having been definitely identified from India. It has been recently identified also as attacking cocoa roots on the Gold Coast and it is said to occur in Uganda.

(7) With *Armillaria mellea* another Agaric was frequently found, often in close association. Superficially, the sporophore is rather like that of *Armillaria mellea* and is white or yellowish in colour. It has, however, no collar on the stalk and its spores are coloured instead of white. When found alone, also, the mycelium of this fungus is quite different from that of *A. mellea* as it is thin and webby instead of being in more or less compact sheets.

It does not, so far as I could see, produce rhizomorphs. It was seen frequently growing on organic matter in the soil, as well as on the stumps of felled spruce trees and on standing dead spruce trees. From the observations I was able to make, it appears to be a saprophyte only. Whether or not the wood attacked by it shows thin black lines resembling those which are characteristic of *A. mellea* is not yet certain and requires further investigation. I have found somewhat similar lines in a detached piece of root in the soil close to a clump of the sporophores of this fungus. Up to date, I have not yet received the identification of this species which is of some importance, owing to the fact that it may possibly be mistaken for *A. mellea.*

(8) Mr. Abdul Hafiz Khan has supplied the following notes on the locally collected specimens of the rhizomorphs of *A. mellea* which were examined by him: "they have a thick dark-brown or black outer covering which forms the rind and is composed of extremely thick-walled brown cells closely welded together without any air spaces. The next inner layer contains thin-walled cells forming distinct parenchymatous tissues often with a yellowish tinge and then comes the central medulla which is made up of thin hyaline hyphæ only. The hyphæ forming the central pith can be easily teased out into separate filaments which do not seem to be laterally united." The fresh rhizomorphs, when first exposed by removing the bark, are pale brown or reddish in colour.

(9) Accepting the characteristic sheets of mycelium, the rhizomorphs and fine black lines in the wood, and specially the mycelium and rhizomorphs, as sufficient evidence of the presence of *Armillaria mellea*, my observations showed that the fungus was very widely distributed on spruce in the localities visited by me. I did not see it on any other species.* As an indication of its wide distribution, it may be mentioned that, on October 3rd, at Bodyar, on a steady walk through the forest of more than

* From what has been said in para (4) above, it seems probable that *A. mellea* also attacks deodar in India. Mr. Hiley (l.c., p. 148) notes that "probably no species of conifer is immune from attack." See also Professor R. S. Troup in *Silviculture of Indian Trees*, III, p. 1107.

four hours, I found evidence of the existence of the fungus throughout the entire distance traversed. It was found, moreover, not only where spruce was comparatively pure but on more or less isolated spruce trees which were surrounded by trees of other species. It was very common also at Deoban and in the almost pure spruce forest of Jaur, below Kanjatra, where nearly all the spruce were dead, I found it on over 80 per cent. of the trees and stumps examined. The fungus, therefore, was obviously a factor of considerable importance and the connection between it and the present outbreak was clearly a matter which required careful study.

(10) With the object of investigating the ability of *A. mellea* to attack and infect healthy trees, on October 6th, at Bodyar, I made a careful examination of the roots of four spruce trees which appeared to be quite healthy and green but which were growing close to dead spruce trees containing quantities of the mycelium and rhizomorphs characteristic of *A. mellea*. The detailed observations are as follows —

(*a*) Healthy spruce, girth 7′ 6″, situated 28′ from a dead spruce containing typical mycelium and rhizomorphs of *A. mellea*. The roots of the healthy spruce were exposed and those running towards the dead tree were followed up to a distance of 16′ from the dead tree but were found, apparently, quite healthy. Within 6′ of the healthy tree was the stump of a felled spruce, one half of which was badly rotted and one half still alive. In the decayed wood of the dead part of the stump black lines were visible and on it were found what appeared to be decayed remains of old rhizomorphs. Although the living part of the stump was apparently more or less grafted to the roots of the healthy spruce, the latter appeared to be quite healthy.

(*b*) (Healthy spruce, girth 8′, situated 9′ and 11′ respectively, from two standing dead spruce containing typical mycelium and rhizomorphs of *A. mellea* and the wood of which showed the characteristic black

lines. The roots of the dead trees, with masses of mycelium between their wood and bark, were in one place actually in contact with, and in another place were only a few inches distant from, the roots of the healthy spruce, but the latter appeared to be quite healthy.

(c) Healthy spruce, girth 5′ 10″, situated 30′ from a standing dead spruce tree containing typical mycelium and rhizomorphs of *A. mellea* and the wood of which exhibited the characteristic black lines. A root of the healthy tree was traced to within a distance of 18′ from the infected tree. All the roots of the green tree, however, appeared to be quite healthy.

(d) Healthy spruce, girth 6′ 3″, situated 17′ and 7′ respectively, from two dead spruce containing typical mycelium and rhizomorphs of *A. mellea*. In this case the roots of the healthy tree appeared to have been grafted on to the roots of the dead tree but not only were the roots of the green tree apparently quite healthy but those parts of the roots of the dead tree, situated below the point of connection with the healthy tree, themselves also appeared to be quite healthy.

The remarkable point emerging from the above observations is that, in the field, there was a sharp and clear distinction between, on the one hand, the healthy roots of the green trees with no signs of mycelium rhizomorphs or black lines in the wood and, on the other hand, the roots of the dead trees which were more or less decayed and with quantities of the characteristic mycelium and rhizomorphs of *A. mellea*. Pending further observations and until control inoculation experiments, under varying conditions, can be carried out, it seems justifiable to draw the provisional conclusion from the field observations detailed above that *Armillaria mellea* does not appear to be capable of successfully attacking and infecting the unwounded roots of healthy trees. For the purpose of such provisional conclusions, it is believed

that field observations are probably, on the whole, more satisfactory than laboratory microscopical examination. The former can be carried out quickly, on a comparatively extensive scale, whereas microscopical examination of a limited range of material may often lead to error, *e.g.*, where the hyphæ of a symbiotic harmless fungus, passing from the tissue of a diseased to that of a healthy tree, are mistaken for the hyphæ of an injurious parasitic species.

(11) The next step in the inquiry was to determine, if possible, what factor was primarily responsible for the weak or diseased condition which facilitated the entry of the fungus and enabled it to attack the trees successfully. On October 9th, at Deoban, I examined a large spruce, the stem of which was dead and in which I could only find what appeared to be the commencement of an attack by *Armillaria mellea* on two roots near their junction with the stem. Of the other roots, some were quite dead and others, although apparently still alive and healthy in places, showed more or less considerable areas of discoloured and obviously unhealthy, or dead, cortical tissue. The base of the stem was badly attacked by insect-borers (specially the Cerambycid larva mentioned in para. 3 above) but, as yet, there were very few borers in the roots. The quite insignificant damage by *Armillaria* in this case was obviously insufficient to account for the death of the tree. Experience gained in other cases indicated that the insects, also, were here of secondary importance and thus attention was directed to the factor responsible for the extensive damage to the cortical tissues, as being probably the one of primary importance in causing the widespread mortality of spruce. A considerable amount of information regarding it had meanwhile been obtained from other trees which had been examined and which appeared to be quite free from *Armillaria mellea* and this information is detailed below.

Incidentally, the case of this tree is interesting because, in it, what appeared to be the mycelium of *Armillaria mellea* was seen attacking roots which, in part at least, seemed to be alive and more

or less healthy, thus indicating, perhaps, that here *Armillaria mellea* may be regarded as a weak parasite.

(12) Before proceeding to the next important factor, however, it is advisable first to summarize the position with reference to *Armillaria mellea* which stands as follows :—

(*a*) During the present inquiry the fungus was found only on one species, *viz.*, spruce.

(*b*) The fungus was not once definitely identified on a spruce tree which appeared to be quite healthy above ground.

(*c*) It was, however, extremely common on dead standing spruce trees, as well as on stumps of felled spruce trees, and fresh sporophores of the fungus were collected which apparently originated from the mycelium in direct contact with the dead wood of the stems and stumps of such trees. In these cases, the fungus appeared clearly to be living as a saprophyte. The fungus occurred chiefly at the base of the trees and was found passing thence, between the wood and the bark, upwards into the stems and downwards into the roots.

(*d*) In one case, however, what appeared to be the mycelium of this fungus was seen attacking roots which, in part at least, seemed to be alive, so that we may perhaps conclude from the observations recorded during the present inquiry that this fungus in India, may be sometimes a saprophyte and sometimes a weak parasite.

(*e*) Field observations have shown no signs of this fungus being able successfully to attack healthy spruce, even when masses of the fungus are present in the immediate vicinity of such trees.

(To be continued.)

DESTRUCTION OF RATS AND PORCUPINES.

The damage from porcupines in the Afforestation division became so alarming that a special gang of Kunjars had to be employed to keep them down, these men were paid Rs. 2 per animal killed. Recently a very simple method has been introduced, which has not failed in a single case. The method consists in pumping poison gas into the porcupine burrows The pump used for this is a simple contrivance, consisting of a chamber into which the gas dust is placed to this chamber a rubber tube about 6' in length is connected. The tube is placed inside the burrow and covered with earth, after which air is forced through the gas chamber and out through the tube into the burrow. The best method has been found to first put a spoon full of dust into each burrow, after which the tube is inserted and covered with leaves and after that with earth (this prevents the gas dust previously put in from being covered with earth), the pump is now used for a couple of minutes, the tube is now pulled out and the burrow left closed up In most cases these burrows have more than one opening, in such cases it has not been found necessary to pump gas into all, but a few of larger ones are selected and only these are pumped, in the others just a little dust is first placed in the opening and then the hole closed with leaves first and mud after.

For rats the proceeding is just the same, their holes are opened and only gas pumped in no leaves are necessary

With 25 lbs. of dust and one machine about 150 porcupine holes were treated and in not a single case were the porcupines able to get out alive. A few holes were dug open two days after and the dead animals found, and in one case where a large burrow was treated no less than 15 porcupines were counted a few days after, where the jackals had dug in and brought them out.

The pump can be had from Messrs. Shaw Wallace & Co., P. O. Box No. 70 Calcutta and costs Rs. 30. The Cyano Gas dust can be had at Re. 1-8 per lb. for 25 lbs. and Re. 1-4 per lb,

or 100 lbs. The saving to this Division in using the original 25 lbs. used can very easily be estimated :—

		Rs.	a.	p.
1. Cost of Pump	... ..	30	0	0
2. Cost of Dust	.. ...	37	8	0
3. Labour	.. .	10	0	0
		77	8	0
Estimated cost of porcupines killed at Rs. 2 per burrow		600	0	0
Saving	.	522	8	0

This is a very low estimate indeed as it is more often than not that the Kunjars used to dig out 5 or 6 porcupines out of each burrow. Further the speed with which an area can be treated is a great consideration, as the writer has personally treated five burrows in 2 hours, each with more than one opening.

A few precautions are needed when using the pump. These are simple, the gas should not be inhaled. If a person, gets effected by the gas, cold water applied to the head and spine and Liq. Ammonia inhaled puts him right.

M. J. McDONALD,
Divisional Forest Officer,
Afforestation Division,
Cawnpore.

Dated 21*st April* 1927.

LEGENDS OF THE SHWEKYUNDAW RESERVE (AS RELATED BY SAYA WET ONE OF THE ELDERS OF INMA-KODOK).

In olden days a very powerful king ruled over the southern Island of Zabudipa. This king was named Ma-Ni-Se-Tha and owned a magic raft which was able to travel anywhere. He steered this raft by pointing his finger in the direction to where he wished to go. If he travelled over land, the ground dis-

appeared and water came in its place so that the raft could float along. The raft moved of its own accord, whether up-stream or down at the wish of the king. On one of his journeys the king came to Inma where he stayed for a time and vowed to build a Kyaung for the future Buddha Ah-Yin-Ma-De-Ya. He planted a teak oar in the ground and the present Reserve has sprung up from this. After the forest sprung up the powerful Nat, named Shwekyundaw, has watched over the teak in order to preserve it to build the Kyaung for the coming Buddha, and if a person dares remove anything from the forest he will be duly punished The Nat is supposed to have the appearance of an old man with very long upper eye lids, which have to be propped up with sticks before he can see anything and no one knows where he lives. There is a Nat-sin put up to him on the east bank of Myitmaka near Inma.

2. The king set up a Paya west of Payagyigon which is almost adjoining the reserve on the north-west. He neglected his wife the queen Mya Sein, and in consequence, she founded a Paya on the west bank of the Myitmaka stream near Inma She set a curse upon the heads of the people of Inma that no great person would ever arise from this village. The king then left Inma and sailed away south down the Myitmaka.

3. Near the P. W. D. bungalow in Inma is the "Bo' paya and the two Europeans who set this up, are supposed to have accompanied the king in his expedition. (Note *i.*)

4. On the banks of the Myitmaka two large lumps of gold were left by the king to pay for the cost of building the Kyaung. The local inhabitants found this gold some time ago and it is only recently that it has disappeared. In the Reserve there used to be nine hillocks, which have now almost disappeared and can hardly be distinguished from adjoining ground. There were also nine ponds in the reserve. Both in the hillocks and ponds silver money was buried for the erection of this Kyaung. (Note *ii.*)

5. Some years ago cowherds found some of this money and used to play games with it. As long as they played with it in the Reserve nothing happened to them, but as soon as they took

it out of the Reserve they suffered from a terrible itching all over the body. As this teak forest was planted by King Manisethu for building this Kyaung or the Ah-Yin-Me-De-Ya no one was allowed to remove any teak for even teak leaves, and the Shwekyundaw Nat would punish anyone who did so.

6. It is said that a man by name of U. Naw of Wetpok felled certain trees with permission from the Forest department. Soon after extraction was completed not only did his elephants die, which were used in extraction, but he and his whole family died. The Forest Officer who gave the permission to extract this timber committed suicide with a dagger (Note *iii*). Mg Yin Maung of Prome obtained a licence to extract some teak which he had converted at Pyaye (now Pyaye is about ¾ miles east from Kodok on the P. W. D. road). The house where he and his men were staying was burnt down. He then carted the timber to Prome and from there rafted it for Rangoon When he reached Tayokmaw the rafts were caught in the whirpool and disappeared. Shortly after his wife went mad and died. His father-in-law died and his pucca residence in Prome caught fire and was destroyed. Shortly after this, he too died. (Note *iv*)

7 Five or six years ago the Divisional Forest Officer arranged with Mg Hla Gyaw, the Inma Thugyi, to extract some teak from the Reserve. The contract was completed when he went blind, and died in August 1926. At the beginning of the rains this year a party went to survey the Reserve and their kit was loaded on bullock carts. For some unknown reason the bullocks took flight and scattered all the kit (Note *v*). A few years ago a free grant of five tons of dead timber was granted to Ma Saing of Inma to build a Kyaung. She died three years ago and left the timber and a sum of Rs. 200 to her sister to complete the work. The sister died and in turn left the timber and money with a man named Mg Po Hla of Inma. One day he fell out of his own gharry and has been lame ever since. He is alive at the time of writing

8. A contractor from Impetlet agreed to cut all creepers in the Reserve. After the agreement was signed he went mad,

3

The people now believe that the Shwekyundaw Nat, who is all powerful, is watching over the Reserve, the surrounding villages and paddy fields. In consequence no harm falls on the villages.

Notes.—

(*i*) This pagoda was set up by two officers of one of the Burmese expeditions.

(*ii*) These ponds are evidently the water-logged "Kans" and "Yos."

(*iii*) I have not been able to find out anything about this.

(*iv*) From the Reserve Journal in 1903-04—1,437 thinnings were sold to this man Mg Yin Maung for Rs. 3,092-4 4.

(This evidently refers to Mr. H B. Barrett, A. C. Forests, who made a survey of the area in 1922-23.

FURTHER LEGENDS ABOUT THE SHWEKYUNDAW RESERVE (FROM OTHER SOURCES).

1. One of the old kings of Burma came down on his raft from Upper Burma and dropped an oar overboard. From this oar the present Reserve has sprung up.

2. The Shwekyundaw Nat is reported to have been seen by some of the villagers. He is an old man with long dropping eyelids and shuffles along with a walking stick. He often assumes the disguise of a Po-thudaw and is dressed in white.

He looked after people who do their best to keep the Reserve, but on those who break the rules he showers dire calamities.

3 A man crossed the Reserve one day and went to Inma At Inma he bought sundry articles and some food. On his return through the Reserve he plucked a teak leaf to cover up the food he had brought. On his arrival home he was wet through, and with some other men he was drying in front of a fire, when he suddenly went mad. The Nat, through a medium, informed the crowd in front of the fire, that he had made the man mad as he had infringed the rights of the Nat by taking a leaf from the Reserve. The people then collected an offering

(Ka-daw-pwe) and carried it to the forest. The mad man seized it and disappeared in the jungle. The villagers followed up but could not find him. After some time he returned to them in his normal mind and was carrying the empty bowl in which the offering had been put.

4 If a man drives his cart through the forest and a teak leaf falls on his cart, he will not be able to find his way out unless he throws the leaf away

[*Extracted from the office of Silviculturist, Burma.*]

THE FORESTS FROM WITHIN, BIHAR AND ORISSA

BY J. W. NICHOLSON, B.A., I.F.S., Bihar and Orissa.
(Superintendent, Government Press, Bihar and Orissa, Patna.)

Under the above title the Government of Bihar and Orissa, have published an attractive little book by Mr. J. W. Nicholson, I.F.S., Provincial Research Officer, dealing with the forests, forest

products and forest management of the province. The object of the book is to interest the educated classes in forests and forestry in their own province, it contains an account of the genesis and progress of the Forest department, of the work done and still remaining to be done, and a graph showing the progress of revenue and expenditure since 1870.

The great forest question in Bihar and Orissa appears to be the conservation of private forests. May we suggest that Government insist on all private forests over a certain size being placed in charge of professional foresters and controlled by working plans approved by Government? This is what is done in Central Europe and the forestry of the private estates is here just as good as the management of the Government forests.

FOREST POCKET BOOK FOR THE CENTRAL PROVINCES.

By V. K. MAITLAND I.F.S

This useful little book will be found of much assistance to forest officers of all grades serving in the Central Provinces and other provinces with a similar climate and vegetation. The inside of the book is much better than the outside. The cover looks as if it had been prepared in some local jail by particularly inefficient criminals instead of by the skilled workmen in the Nagpur Government Press. In the inside, however, will be found silvicultural notes on the main Central Provinces species and their artificial reproduction, a chapter on forest roads and buildings and their construction and one on the utilization of the ordinary classes of forest produce. Special chapters are devoted to minor forest produce and general statistical data for teak and sal.

The author has taken a lot of trouble in gathering together much useful information in one small handy book which every local forest officer should keep constantly with him and what is more important refer to.

EXTRACTS.

THE FORESTRY BILL.

(SECOND READING.)

Mr. McNeill, Financial Secretary to the Treasury (Canterbury), moved the second reading of the Forestry Bill, which, he said, with the exception of one very small detail, was identical with the measure which was introduced last year, but which was dropped for the lack of Parliamentary time. It was confined to two purposes only: it gave power to increase the number of Forestry Commissioners from eight to ten, and it enabled the Commission to make by-laws, with appropriate penalties, for the management of the woods under their charge. It was desirable to increase the number of the Commissioners because there had been a very considerable increase in their work since they were established by the Act of 1919. Their work has become more varied since the introduction of the scheme for providing forest workers' homes.

The necessity for making by-laws was a much more urgent matter. With these huge woods under their management a responsibility was cast upon the Commissioners for preserving the amenities of the woods and preventing careless damage, and, most important of all, they were enabled to take safeguards against the danger of fire. It was not only a matter affecting old woods, where destruction, both of beauty and utility, might be wrought, but young woods, planted in close masses, were liable, especially during the summer months and in the very light soils of the Eastern Counties, to be ravaged by fire, which in a few hours might wipe out the work of years, and inflict serious pecuniary loss on the country. He asked the House to pass this measure, so that by-laws could be put in operation, before the summer. He believed Mr. Johnston, who had put down a motion for the rejection of the Bill, did not object to what was in the Bill, but wanted the whole scheme of the Forestry Commission altered. That was an intelligible view, but this was

not the moment to bring it forward. He was not concerned at present to express any view as to whether the Forestry Commission ought to be definitely under a Minister of the Crown in the way in which other Departments were. The present experiment was entered upon in 1919. The Acland Commission which embraced all parties in the House, had laid it down as their judgment that it would be best that the Forestry Commission should be a body independent of all political ties and pressure, and that, while one member of the Commission should be a member of the House of Commons, no member should be in receipt of Ministerial salary. This meant that the Commission should not be part and parcel of the responsibility of any Government Department. (Mr. Trevelyan: Is not Lord Lovat a member of the Government?) He was not a member of the Government as a Commissioner. The Act of 1919 was brought in consequence of the report of the Acland Commission, and the constitution they suggested was adopted At that time Parliament acted on the best advice that could then be given A sum of money was set apart to be at the disposal of the Forestry Commission for activities which were entrusted to them for ten years. This departure from ordinary financial procedure was made in order to carry out the intention of divorcing the Forestry Commission as far as possible from politics. The experiment was proposed for ten years, which would come to an end in 1928-29. There must, therefore, be a review of the whole position during the next year or 18 months, and he suggested that any attempt to subvert the constitution of the Commission might reasonably be deterred until that occasion.

THE REJECTION MOVED.

Mr. Johnston (Dundee, Lab.) moved the rejection of the Bill. He said that no one had the slightest desire to hamper the activities of the Forestry Commission, but there was no justification for Mr. McNeill's statement that if they obstructed a non-essential part of the Bill they were doing something detrimental to the progress of afforestation. Under the present constitution of the Forestry Commission that was the only opportunity they had of

raising the whole question of afforestation, which was of tremendous importance. We were now facing a world timber shortage. Last year we imported £52 750,000 worth of timber, the overwhelming proportion of which could be grown at Home. We also imported £9,250,000 worth of wood pulp, which could be raised at Home: or a total importation to the value of £62 000,000. In the national interest the present control of the Forestry Commission and the present methods of raising timber in this country ought to be changed. The Government ought immediately to reconstitute the Commission. The prices of timber were raising. Between 1890 and 1920 American soft wood had risen by 200 per cent. and wood pulp—the raw material for newspapers—by 282 per cent. *The body controlling this situation was undoubtedly the Forestry* Commission. Six out of the eight Commissioners represented the landlord interest. Since 1920, the landlords had received £180,000 by way of gift to prepare their land on which to grow timber, and last year they got £31,000.

What effect had the work of the Forestry Commissioners on unemployment? In the summer they employed 1,980 men, and in the winter 2,960. In India 6,000 000 men were making a living out of the forest—which, of course, had been long developed—and the Indian Government drew an annual profit of £2,000,000. In Germany over 1,000,000 men were employed, and in one Department in France alone, 30,000 men. By correlating the work of the Forestry Commission with that of other Departments, the Commission could absorb thousands of unemployed men and give them work which would be economically profitable to the State. At present we had 1,500,000 people unemployed, and, since the Armistice, we had spent £380,000,000 on public relief, for which we had got nothing in return.

Mr. McNeill interposed to say that the Forestry Commission were now planting more than any other country in the world, not excepting the United States.

Mr. Johnston said it might be that we were planting more now. But the best answer to the right hon. gentleman was a leading article in *The Times* of January 11th which said that at present, partly because of past neglect and partly because of the

wastage of the war, the need for a consistent policy of afforestation was more urgent than it was when the Acland Commission presented its report in 1918. The article further pointed out that something like nine-tenths of the country's timber supply came from abroad; and that while on the Continent timber was grown on one third of the total land area here the proportion was only about 4 per cent He called attention to the heavy cost of the administrative side of the Forestry Commission. Since the Armistice the expenditure on the purchase of land and on planting was £970,000 and on administration £302,000. He thought it was wrong that a nominated group of individuals, such as the Commission, should be spending public money without being subject to the control of Parliament.

Mr. W. Baker (Bristol, E., Lab.) seconded the amendment for the rejection of the Bill

Mr. Hilton Young (Norwich, U.) hoped that the Forestry Commissioners, in administering the ancient forests which had formerly been under the control of the Commissioners of Woods and Forests, would have regard to their amenity value, and would not be guided solely by rigid business considerations. In regard to the Bill, the Financial Secretary to the Treasury had made out a good case for it.

Mr. Macpherson (Ross and Cromarty, L.) said that, while he was satisfied that the Forestry Commission had done excellent work, although not represented officially in the House, it was most desirable that the Commission should be represented by a Minister.

Sir D. Newton (Cambridge, U.) supported the second reading of the Bill. He urged that there should be no stealing of agricultural land for afforestation.

Mr. Buxton (Norfolk, N., Lab.) said the view on that side of the House was that the work of the Commission would be better controlled if a Minister were directly responsible for it.

Mr. McNeill said that he did not in the least want to prejudice the question whether or not there should be Ministerial control, That was a very big and controversial matter and could

not be decided at that moment. All they wanted at present was the safeguard given in the Bill.

Sir A. Hopkinson (English Universities, U.) expressed satisfaction that no by-laws could be made regulating the access of the public to the New Forest or the Forest of Dean except after consultation with the verderers of those forests. A point of great importance, however, arose in regard to the Valley of Ennerdale one of the most attractive parts of the Lake District There was a great scheme of afforestation there, which had given rise to considerable doubt and difficulty in the minds of those who were interested, above everything else, in preserving the right of perambulation by the public among the mountains. That right was prized by all classes of the community. Mainly through the generosity of individuals, a large proportion of the mountain tops around had been given to the public trust, and access to them was obtained largely through Ennerdale The question arose whether, under the Bill, by-laws affecting this right of access could be made. He did not think that Clause 2, which gave power to make the by-laws, protected the public right of access to the mountains.

Colonel Wedgwood (Newcastle-under-Lyme, Lab.) urged that the work of the Forestry Commission should be transferred to the Minister of Agriculture.

Sir L. Forestier-Walker (Monmouth U.) said the charge made against the Forestry Commission of lack of activity was quite unfair. They had done excellent work, and were carrying out the task that Parliament had set them. If the work were undertaken by the Board of Agriculture it would inevitably mean separation between Scotland, England, and Wales, and would have a very grave effect on the service generally. One of the Commissioners to be appointed under the Bill would undoubtedly be Sir John Sterling Maxwell, who had done such a great deal for forestry in this country. The other new Commissioner would be one who had a knowledge of the conversion and sale of timber

Mr. W. Graham (Edinburgh, C., Lab.) said the objection of the Labour Party was to the whole system underlying this Bill.

Sir G. Courthope (Rye, U.) agreed that Parliamentary control of finance should be as full as possible, but he begged the House

to be extremely careful, lest in their desire to keep closer control over the expenditure upon forestry they did not destroy its efficiency, which depended upon continuity of policy over a series of years. He suggested that, instead of a Minister being at the head of the Department, it should be represented in that House by a junior member of the Government, who would speak for it and be open to attack, but who would not be the head of the Department.

After further debate the amendment for the rejection of the Bill was defeated and the Bill read a second time by 235 votes to 125—majority 110.—[*The Times, 3rd March 1927.*]

NEW FOREST BEAUTY SPOTS.

(PROPOSED ADVISORY COMMITTEE.)

At a meeting held in the New Forest yesterday morning Lord Lovat, Chairman of the Forestry Commissioners, said the Commissioners proposed that an advisory committee should be appointed from the National Trust, the Commons and Footpaths Preservation Society, the New Forest Association, and the Verderers, to advice and confer with the Commissioners as to the treatment of decaying woods which might be included among the beauty spots of England

Lord Lovat first visited the Parley Old enclosure with a number of prominent commoners, among those present, being:—

Sir Hugh Murray, one of the Forestry Commissioners; Mr. Osmaston, Deputy Surveyor of the New Forest; Major J. D. Mills who is a Verderer and also hon. sec of the New Forest Association; Mr. T. Stovold hon. sec. of the Commoners' Defence Association; Mr. S. Hamer, hon. sec., National Trust and Mr. F. Robey, of the Commons and Footpaths Preservation Society.

The party walked through the enclosure, and Mr. Osmaston explained what had been done by the Commissioners, and the system on which it was proposed to rejuvenate the old woods

which, he said, would be treated in groups, the process being spread over 15 or 20 years.

The party afterwards assembled at King's House, Lyndhurst when Lord Lovat reviewed the position as viewed by the Commissioners. He said that in the New Forest Act they had a difficult Act to administer and an Act which had been interpreted in a good many ways by different people. With regard to the treatment of woods inside the enclosures, as was stated in Lord Manners's letter the other day, there were certain areas which he regarded as of national importance, and which they did too. These areas should be treated from the point of view of the maintenance of their beauty, not only at the present time but in the future, and the question of the revenue should not form any part of it. They were prepared, within limits, to spend money in order to keep up the present standard of beauty. The rest of the forest would be treated as laid down in the new Forest Act of 1877.

After explaining the proposal to constitute an advisory committee, he said that if they had a body such as he had mentioned they would be able to go into this most difficult question with the greatest possibility of success. What he had said only applied to enclosures. The Forestry Commissioners did not intend to carry out any more felling until such time as the committee had been appointed and had had an opportunity of 'functioning.'—[*The Times, 3rd March 1927.*]

AERIAL FOREST SURVEY.

PILOT'S WORK IN CHITTAGONG DISTRICT.

Leaving Chittagong this morning at eight, Mr. Vincent, of the Air Survey Company, arrived here at 4-30 P.M. and landed on the racecourse, halting at Akyab for an hour for petrol. During his journey he met with thick clouds over the hills and air pockets, particularly over the Yomas, which he crossed at a height of 10,000 feet. Otherwise the journey was uneventful, the weather both at Chittagong and Rangoon being fine. Mr. Vincent

has been at Chittagong for about 2½ months and has surveyed 1,200 square miles of country. After stopping here four or five days, he will fly to Penang, where he will carry out more forest survey work.—[*Pioneer, 27th March 1927.*]

AFGHANISTAN.

FOREST SURVEYS

A separate branch has been organised in the Ministry of Agriculture and Commerce to deal with forests. A survey party has been sent to Jaji forest where 15,000 trees have been sold Forests can yield a considerable income to the Government There are numerous forests in the eastern and the southern provinces, and in Herat, Badakshan and Qatghan. -[*Pioneer.*]

FINDS IN CUTTING UP TIMBER

Very curious things are sometimes found by the operator of the circular saw as he cuts up trees. Pieces of wood, iron, lead and other substances make their appearance as the timber is opened up and divided.

Though the fact is not always appreciated, it is the case that metals, like paper or wood, burn away on the application of heat. A very little metal, but still some, is always left behind when a branding iron is applied to wood. An instance of this may be found in the case of a tree felled some years ago in the Midlands, allusion to which is made in Tennyson's poem "Aylmer's Field."

"That old oak.
"So old that twenty years before a part
"Falling had let appear the brand of John."

In Baker's "Tennyson Dictionary" is a note on these lines by J. F. F., initials which may probably be allowed to assume to be those of Canon Fowler, of Durham, by whom they were often used in writing to the press :—

A bit of oak bearing the two Roman letters I. R. was given to his grandfather, William Fowler of Winterton, some sixty

years ago by a gentleman in the neighbourhood of Newark. The letters which are a little over an inch in height, are cut or branded directly across the grain of the wood. Attached to the fragment is a label inscribed as follows :—

"This piece of wood was found in an oak tree 15 inches below the bark, and contained the initials of King John, who died at Newark 600 years ago."

Medieval arrow heads are not uncommon. In the museum at Winchester may be seen several which were found in a tree on an estate near Bisnopstoke, in Hampshire. The descriptive label attached explains the circumstances of the find as follows :—

Four iron arrow heads were found embedded in the centre of an old yew tree at Fair Oak when the dead wood was being cut away. The long cone shaped arrow head was not used in Europe till after the Crusade ; it is of Saracen pattern and is armour piercing. Probably all were shot from the long bow. They may have been shot into the yew tree by archers training for the latter Crusades The gift of finder, Lt.-Col. Edward Cheke, 1924.

These four arrow heads vary in size, the largest being about 8 in. long by 1 in. broad, and the smallest about 3 in. in length by [illegible] in. breadth. Only one of these arrow heads is cone-shaped, the remaining three having, as it were, a broad blade for the head with a shank.—[*The Timber News.*]

PUNJAB FORESTS.

A little booklet by Mr. Sohan Lal, B.A., lecturer at the Central Training College, Lahore is useful as a means of disseminating information among students, and even among people other than students, who have not fully appreciated the value of forests, especially in a province such as the Punjab. The author claims that the Forest department is the guardian of the Punjab canals, on which the very life of the population depends, inasmuch as without forest conservation there would be little or no water in the rivers in the dry season, and in the rains heavy

floods would be liable to damage or destroy canal headworks as well as railways, roads and bridges. This is, to a large extent' true, without forests in the catchment areas, the run-off would be rapid and excessive, and what is wanted in the rivers is, as far as possible, a steady flow neither little or no discharge on the one hand nor high and destructive floods on the other. The author further says that the Punjab in ancient times was covered with forests, which, with the advance of agriculture and increase of population haye disappeared, and we do not find now the forests which were the hunting grounds of the Mogul Emperors. That, however, may be liable to misunderstanding. The Punjab is by nature an arid country, and as far as historic times go it could not have had what would usually be termed forests, such as the forests of tracts which have a humid climate The hunting grounds of the Mogul Emperors in the alluvial plains were no more than scrub jungle areas, on which were very stunted trees or mere bushes, *jand, jal. karil, pilchi* and vegetation of that kind. The deserts of the Punjab, can hardly be described as forests, they were in the main almost rainless, barren waste, dotted at the best with sad coloured shrubs, shrinking despairingly from the lash of the scorching winds. Forests require water, and the Mogul Emperors made canals because the country was so waterless, and more than four centuries ago an Emperor ordained that whoever planted a grove, among other things, should receive special recognition in exemption from taxes. Trees were evidently greatly to be desired and the planting of them encouraged, because the countr was so treeless.

The total area now occupied by forests in the Punjab stated to be 6,238 square miles, and that includes the hill and mountain forests. Even so, the area is only one-sixteenth of the whole area of the province, and taking the whole of India the forests occupy one-fourth of the total area In Burma and Assam the proportion of forest land to total area is over 50 per cent, so the forest area of the Punjab is still low, although the Forest Department has been busy in conservation and afforestation during the last forty or fifty years. The oldest of the Punjab plantations is that at Changa Manga at the tail of the Upper

Bari Doab Canal, and Mr. Sohan Lal says that the fuel annually obtained from it, if arranged in stacks 5 feet wide and 5 feet high, would extend for a length of 10 miles. The net revenue of the plantation is said to amount to Rs. 2,50,000 or Rs. 85 per acre per annum. And apart from the respectable revenue derived from the Punjab forests as a whole in the ordinary way, the Department has established a factory at Jallo, near Lahore, which had an output of 56,431 maunds of rosin and 142,476 gallons of turpentine in 1923, and it is said that there are good prospects of an important export trade after meeting local demands. A syndicate is also proposing to erect a factory near Tajawala on the Western Jumna Canal to make pulp and paper from the material obtained from the adjoining forest areas. A project is further under consideration for manufacturing matches from Punjab fir, spruce and pine at a factory on the Beas river. There are other commercial enterprises, involving the use of forest products, which are being considered; and altogether every one will agree with the author of the booklet regarding the valuable work that is being done by the Forest department in the interests of the Punjab.—(*Indian Engineering*, *26th March* 1927.)

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INDIAN FORESTER

SEPTEMBER 1927.

THE FIRST *INDIAN SLEEPER-TREATING PROJECT.

1913-14 to 1916-17, by R. G. M.

Mr. Pearson's earliest experiments at Dehra Dun on the preservative treatment of indigenous sleeper-woods were made in 1909-10. By 1913, as a result of his researches, two projects for creosoting sleepers on a large scale were in the air.

One of these was a proposal to instal pressure-treating plant in the Andamans, to creosote 50,000 broad gauge sleepers of *gurjan* (*Dipterocarpus spp*, and other Andamans timbers per annum. Nothing came of this.

The other was the arrangement which Sir G. S. Hart, Inspector-General of Forests, made with the Railway Board and the Forest department in the United Provinces for the supply of creosoted *chir* (*Pinus longifolia*) sleepers from the Kumaon forests. Under this arrangement, the Government of the United Provinces undertook to creosote one million broad gauge *chir* sleepers and to sell them to the North-Western Railway and Oudh and Rohilkhand Railway at Rs. 3-8-0 apiece

As the price may sound surprisingly low in these days, it must be recalled in passing that the average prices of broad gauge sal, deodar and teak sleepers in 1912-13 were about Rs. 4-8-0, Rs. 4-4-0 and Rs 5 respectively.

* The East Indian Railway are believed to have imported a creosoting plant as long ago as 1866 for the purpose of treating Himalayan pine, spruce and fir sleepers. Very little use seems to have been made of it, as the creosoted sleepers proved too expensive. In those days, sal and deodar were probably cheaper.

It was, of course a considerable experiment in those days to order a million creosoted *chir* sleepers; for Mr. Pearson's experiments had not been going on long enough to prove their durability; and, besides, there are always risks to be taken when putting the results of research to the test of practical use on a commercial scale. Quite rightly, therefore, instructions were given to Railway Engineers not to lay the sleepers in important main lines.

The sleepers were treated with a mixture of creosote and liquid fuel oil in open tanks at Tanakpur, Kathgodam and Hardwar. These are railway stations at the foot of the hills and on the banks of the Sarda, Gaula and Ganges rivers, down which the sleepers were floated from the hill forests.

The absorption of the preservative mixture was about 15 lbs per sleeper, *i.e.*, about 10 lbs. per sleeper less than the quantity that pine sleepers are usually made to take up when treated under pressure by the ordinary full cell process. Penetration was good in the sapwood, but so slight in the heart-wood that fears were expressed that the zone of creosoted heart-wood would soon be destroyed by abrasion of the surface. The spike holes were not bored before treatment, or were bored at one end only.

The operations * were started in 1913-14. Several unforeseen difficulties were encountered, with the result that the annual output of treated sleepers was only about a third of the estimate. The most serious effect of this low output was that it added enormously to the proportion of depreciation, interest charges and supervision costs per sleeper. The business did not prove remunerative to the Forest department; and the Government of the United Provinces were probably not at all sorry when, in 1917, the work had to be closed down altogether owing to the

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* For a detailed description of the sleeper-treating operations, *vide* the Annual Reports on Forest Administration in the United Provinces for the years 1914-15 (paragraphs 197 to 226), 1915-16 (paragraphs 47 and 48) and 1916-17 (paragraphs 45 to 52).

impossibility of getting any more shipments of creosote during the war. Apparently creosote could not be obtained in India in those days.

The total number of sleepers treated and delivered to the Railways was about three lakhs.

They were laid in the N.-W. R. and O. & R. R. track in the years 1915, 1916, 1917 and 1918 After which they were practically forgotten for a number of years. The only surviving records of the sleeper-treating operations that the Forest department possesses are in the annual administration reports of the Forest department in the United Provinces. Fortunately it was just before the old fashioned type of administration report, with its wealth of detail (superfluous for the moment, perhaps, but often invaluable for future reference), was sacrificed on the altar of Financial Stringency. Many of the sleepers were doubtless used for casual renewals and consequently cannot be traced without great trouble. But the Railway Engineers kept records in their offices of the localities in which about two lakhs of them, used for continuous renewals, had been laid.

During the past few months, fifteen sections of track about 100 miles in all, which were laid with these creosoted *chir* sleepers in the years 1915 to 1918, have been specially examined and reported on. The results, which are briefly summarised below, will be of interest to Forest Officers, because these are the only indigenous treated sleepers of any kind that (*a*) have been in the track long enough, and (*b*) have been used by railways in large enough numbers, to yield conclusive evidence of their practical value.

The results have been variable and would doubtless have been worse had the sleepers been laid in main lines with fast and heavy traffic. But, bearing in mind (*a*) the comparative inefficiency of the open-tank system of treatment, and (*b*) that the spikeholes were not pre-bored, they justify the expectation that the preservative treatment of Himalayan soft-woods will in time and with further experience, develop into an important industry.

SUMMARY OF RESULTS ON 199,924 CREOSOTED CHIR SLEEPERS LAID IN THE N.-W. RY. AND O. & R. RY. TRACK IN THE YEARS 1915 TO 1918.

(i) Replacements up to date from o per cent. to 5 per cent

General condition satisfactory		General condition moderate to poor	
Approximate Mileage	Number of sleepers originally laid	Approximate Mileage.	Number of sleepers originally laid
42	84,367	15	29,022

(ii) Replacements up to date from 5 per cent. to 10 per cent

General condition satisfactory.		General condition moderate to bad.	
Approximate Mileage.	Number of sleepers originally laid	Approximate Mileage.	Number of sleepers originally laid.
16	33,348	8	16,885

(iii) Replacements up to date from 10 per cent. to 22 per cent.

General condition fairly satisfactory.		General condition poor to bad.	
Approximate Mileage	Number of sleepers originally laid	Approximate Mileage	Number of sleepers originally laid
12½	25,030	6	11,372

Very little damage by white-ants has been observed. The *chief cause of failure has been splitting, which has opened up* passages for the entry of decay into the internal zone of untreated heart-wood.

R. G. M.

28th May 1927.

MORTALITY OF SPRUCE IN THE JAUNSAR FORESTS, UNITED PROVINCES *(concluded)*.

(Continued from pages 434–43, August issue.)

(iii) Sun-Scorch.

(13) At the commencement of this inquiry I noticed that the dead spruce seemed to occur most frequently on exposed ridges and in places where the trees seemed likely to suffer especially from drought. I accordingly asked for and obtained the following figures regarding the local rainfall in recent years :—

Year	Figures showing the rainfall and snowfall (combined), at Chakrata, as supplied by the Meteorological department, Simla.	Figures of rainfall only, at Deoban supplied by Mr Hira Singh, E. A. C. Forests.
Normal	73·01	...
In year 1917 ...	82·29	117·37
„ 1918	47·36	38·58
„ 1919	76·84	71·81
„ 1920	39·79	52·61
„ 1921	54·67	86·02

From the inquiries I made locally, it appeared that the death of the trees first attracted attention in 1918 and that most of the trees died in the years 1920 and 1921. The figures given above indicate that, at Deoban, in 1918 and 1920, the rainfall was very small, while, in the years 1918, 1920 and 1921, there was a decidedly deficient rainfall and snowfall, generally in the locality, and it thus appeared that drought, to some extent at least, was responsible for the deaths. Several observations which I was able to make in the locality also seemed to support this view. As a general rule, the deaths were seen to be principally on hot

westerly and southerly slopes and to be much less frequently on cool northerly slopes. Thus, in the very badly damaged Jadi forest, on a spur running N.-W. to S.-E., the trees on the north-east slopes were healthy while, on the south-west slopes many trees were dead. A case was also seen where spruce fully exposed to the sun on the south had died, whereas another tree in the vicinity, apparently similar to these but which was shaded on the south side by *kharshu* (*Quercus semecarpifolia*) was healthy.

In several cases, the deaths were found to be most frequent at the bottom of slopes on the steep, stony edges of dry water-courses.

In such cases, less soil appeared usually to be available for these trees than in the case of those situated higher up the slopes, this soil also was exposed to drying out on two surfaces instead of one, *viz.*, from the upper surface of the ground level and laterally from the bank of the water course, while the trees had little or no side-shelter from below and were subjected to reflected heat striking up from the rocky bed of the water-course.

(14) That this was not a simple case of ordinary drought-damage, however, was indicated by two remarkable facts, *viz.*, (*a*) the damage was almost entirely confined to one species, *i.e.*, spruce, and other species of trees, such as deodar, silver fir and oaks, even when growing in the immediate vicinity of the damaged spruce, almost invariably appeared to be quite healthy and (*b*) the injured trees did not, as a rule, become stag headed and die back from the apex, as is usually the case in drought-damage. A careful examination was accordingly made of a number of sickly, but still living spruce in order, if possible, to discover precisely what the injury was and the earliest indications of it. This showed that, in trees which were obviously dying and in some cases almost dead, in which no damage at all (or in some cases obviously quite insignificant injury) by fungi or insects could be detected in the field, there were obvious signs of severe damage from what appeared to be undoubtedly sun-

scorch. The following spruce trees examined at Deoban, on October 11th and 12th, may be taken as examples :—

(a) Girth 2′ 11″, on a W. to S.-W. slope, obviously sickly, damage by fungi or insects not noticeable, roots as a rule healthy but show patches of discoloured, obviously unhealthy, cortical tissue, stem apparently healthy but the lateral branches more or less stag headed and showing extensive areas of discoloured, unhealthy or dead, cortical tissue, a few small insect borers here and there in these sickly branches but damage done by them insignificant, the healthiest part of the crown is the terminal shoot.

(b) Girth 6′ 10″, near top of hill, nearly dead roots appear healthy, upper two-thirds of stem fully exposed to sun on south, crown of branches is limited to upper one-third base of stem shows bad stem cracks, discoloration in cortex very bad and has extended to the wood, these dark, discoloured, apparently scorched, areas are now being attacked by insects.

(c) Girth 4′ 2″ fully exposed to sun on S.-W., obviously sickly, discoloration of cortex with local accumulation of resin bad, both in roots and at base of stem, stem has no lateral branches except near apex and shows signs of old healed cracks in bark. The primary damage, therefore, appeared to be due to the local drying out and killing of the cortex by sun-scorch. In the healthy twigs and branches of spruce, there is usually a very thin outer corky layer, below which is a layer of green tissue containing chlorophyll and then the white, or pale pink, inner cortical tissues. The latter, when cut, exude resin freely.

Twigs and branches which show the first signs of discoloration in the cortex appear to be much drier than usual and when cut, where they appear to be still alive and healthy, resin does not exude freely from them. In the discoloured areas, which may include only the chlorophyll containing cells or all the cortex down to the wood, the tissues are brown in colour and in or near them there is usually a more or less marked accumulation of resin

which also is frequently seen exuding from the stem and branches. In the roots, observations showed that, in hot exposed situations, the roots situated on the south and west of the stem were often considerably damaged, while those on the north of the stem were comparatively healthy. Again, in thick roots, the more exposed upper surface was frequently more damaged than the comparatively protected under-surface. Roots, stems and branches with injured areas of cortex were clearly favourite points of attack for insect-borers which were frequently seen commencing operations in them.

Microscopic examination of specimens of damaged cortex from the stem showed that they were practically free from the hyphæ of fungi or with a few hyphæ in the dead tissue only. In similar specimens from the roots, hyphæ were rather more frequent but they appeared to be of quite subsidiary importance. If, as has been indicated above, the primary damage to spruce is due to sun-scorch, fungi and insects subsequently attacking the injured trees and being of secondary importance, in those cases where conditions for infection by fungi are probably not very favourable, we should expect insects to be the most prominent secondary agent. This does appear to be the case, as will be seen from the details of the following eight trees examined in a valley at Bodyar, on October 5th :—

—	Number of trees with		
	Armillaria mellea	Insects	No obvious signs of *A. mellea* or insects
(A) On slope with nothern aspect, in close forest. Four standing dead spruce.	4	...	...
(B) On slope with southern aspect, immediately adjoining and opposite (A), open and grassy with trees more or less isolated. Four standing spruce, three dead and one sickly.	1	2 (1 sickly)	1

Thus, in this case, where trees were comparatively widely scattered on a hot slope exposed to the south, *Armillaria mellea*

was comparatively rare and insects were relatively conspicuous. At the same time, both insects and *A. mellea* are frequently found attacking the same trees. Thus, in the very badly damaged, almost pure, spruce forest at Jadi, out of 18 dead trees examined, one tree showed *A. mellea* only, three trees showed insects only and 14 trees showed both insects and *A. mellea*.

The remarkable point that the terminal shoot is often the healthiest part of the crown in trees showing damage by sun-scorch is possibly explained by the fact that the water, ascending the stem in the deeper inner layers of wood in the lower part of the stem, is probably more protected from drying out than that which passes through the outer layers and into the comparatively slender lateral branches, while towards the apex of the tree the stem is more shaded from the sun by the denser crown of closely-foliaged, upwardly-directed twigs

A point which, at first sight, seems difficult to explain under the theory that the damage is primarily due to sun-scorch is that not infrequently on hot grassy slopes with a southern aspect, more or less isolated, small or medium-sized spruce may be seen which are quite healthy. It is believed that these probably owe their immunity primarily to the fact that they have an unusually dense crown, well branched almost to the ground, the foliage and branches thus, to some extent, sheltering the soil at the base of the tree from the sun's rays and also protecting the thin-barked roots and stem from sun-scorch. The roots are usually close to, and are often partly above, the surface of the soil. That shade over the soil and roots may be beneficial, as regards protection from sun-scorch, was apparently indicated by the case of an isolated spruce seen on a hot ridge above Jadi, fully exposed to the south, but which was well branched and provided with foliage to the base. The ground surrounding the base of this tree was protected by a dense mat of *Cotoneaster microphylla*, Wall. and although the tree was stag-headed, its lower branches appeared to be quite healthy and green. The immunity of the silver fir, even when growing quite close to spruce which has been seriously injured, is very striking. It is believed that this is due, in part at

least, to the silver fir having, as a rule, a closer denser crown than the spruce which also is usually developed low down on the stem and with the lower lateral branches somewhat inclined downwards, the sun's rays thus not impinging so directly on the surface of the lower part of the stem and of the lateral branches as seems to be the case in the more open crown, with horizontal branches and pendulous twigs of the spruce which, moreover, is often limited to the upper part of the stem. In the older trees, also, the bark of the silver fir is somewhat thicker and more deeply fissured than that of the spruce. The freedom from injury of deodar was no less striking than that of silver fir and the cause of its immunity is less apparent On October 5th, at Bodyar, on a hot open grassy slope with a south westerly aspect, I found a spruce 2′ 3″ in girth, which had a comparatively low and well developed crown but which was evidently very sickly. On the south-west of the tree, the roots showed extensive areas of dead cortex which insect-borers were commencing to attack. At a distance of only 15′ from this spruce was a deodar, 2′ 10″ in girth, which appeared to be quite healthy, both in roots and crown, although its branches did not appear more obviously protective to the stem and roots than were those of the spruce.

It must, however, be borne in mind that species differ not only in structural or morphological characters but also in such points as the osmotic power of the cell-sap. Owing to differences in this respect, some xerophytic species, for instance, may be able to obtain some moisture from a dry soil and thus avoid injury by desiccation or high temperature which other species, with a less powerful cell-sap, may be unable to escape. It is possible that deodar owes its immunity, in part at least, to some characteristic difference of this kind.

(15) The only other species which suffered injury to any considerable extent, in addition to the spruce, was the blue pine (*Pinus excelsa*, Wall.). Several sickly trees of this species were examined, in a hot valley, on slopes with a southerly aspect, at Bodyar, and in their case the general character of the injury appeared to be precisely the same as that which has been described above with reference to spruce. In five sickly trees examined

there were no obvious signs of damage by fungi or insects. Discoloured patches of dead or unhealthy cortex extending down to the wood, however, accompanied by local accumulation and exudation of resin, were invariably found, especially at the head of the roots and at the base of the stem, and, as in the case of the spruce, the terminal shoots at the apex of the crown were usually less injured than the lower lateral branches.

Microscopic examination of the areas of damaged cortex revealed a few hyphæ which were almost invariably confined to the dead tissues and appeared to be of little importance. Near these sickly trees a dead blue pine was seen, 3' 2" in girth, the stem of which had been badly attacked by a borer. Specimens of the latter were identified by Dr. Beeson as *Polygraphus niger*, Steb., who reported that the insect was believed to be secondary and not the primary cause of damage to healthy trees.

(11). Summary of Chief Results and Suggestions regarding Preventive and Remedial Measures.

(16) The chief results of the present inquiry are now summarized below :—

(*a*) *Fomes annosus*, has been found on two new hosts apparently not hitherto recorded in India, *viz*, spruce (*Picea Morinda*) and silver fir (*Abies Pindrow*) para. (2).

(*b*) As the Indian fungus differs somewhat from the European form, it has been named *F. annosus* var *indica* Wakef., para. (5).

(*c*) *Armillaria mellea* has been discovered in India, apparently for the first time, and a brief general account has been given of the fungus, as well as of another species which may be mistaken for it locally, paras. (6), (7), (8) and (9). *A. mellea* was found only on spruce (*Picea Morinda*).

(*d*) It is pointed out that both *F. annosus* and *A. mellea* apparently occur, occasionally, on one and the same tree, that *F. annosus* does not appear to produce

rhizomorphs and that those rhizomorphs which have previously been attributed to this species probably belonged to *A. mellea*, para. (4).

(*e*) With reference to the primary object of this inquiry, *viz.*, the cause of the severe local mortality of spruce in the years 1918—1921, *F. annosus* appears to be of practically no importance, para. (3).

(*f*) Although *A. mellea* was found in a very high percentage of the dead trees and stumps of felled trees examined, it is probably a factor of only secondary importance, it being apparently only a saprophyte, or possibly a weak parasite in the case of the mortality at present under discussion, paras. (10) and (11).

(*g*) The primary cause of the damage to spruce is believed to be sun-scorch, the unusual severity and widespread occurrence of which were apparently chiefly due to decidedly deficient local rainfall and snowfall during the years 1918 and 1920, paras. (13) and (14).

(*h*) The only species which suffered severely from sun-scorch were spruce (*Picea Morinda*) and (to a considerably less extent) blue pine (*Pinus excelsa*), paras. (14) and (15).

In connection with this point, it is interesting to note that in Europe, the conifers most liable to damage by sun-scorch are usually considered to be the spruce (*Picea excelsa*, Link.) and the Weymouth pine (*Pinus Strobus*, L.)

(17) With reference to suggestions regarding preventive and remedial measures, the first points of obvious importance are to maintain a good admixture in spruce woods of other species which do not suffer from sun-scorch, such as deodar, silver fir and oaks, to encourage the development of a good crown low down on the stem on trees exposed to the south and west, to avoid exposing trees to the sun which have a small crown confined to the upper part of the stem only and to keep the soil and roots protected from the direct rays of the sun by undergrowth.

As it is probable that many of the less seriously damaged trees would recover if they were not subsequently attacked by insects and fungi, such as *A. mellea*, it is important to bark or cut up and remove from the forest as rapidly as possible all dead standing and fallen trees and such sickly stems as seem to be obviously dying. These dead and almost dead stems form centres for the propagation of insects and fungi on a large scale and greatly increase the risk of infection to other trees. Felling wastage should be burnt and the crop kept as clean as possible. As damage by sun scorch is likely to be particularly severe after years of deficient rainfall or snowfall, especial attention should then be paid to the location and rapid exploitation of dead and obviously dying trees. In these forests, in the past, spruce has in some cases, been girdled to favour the deodar, but it seems advisable rather to fell and remove such trees as quickly as possible. Apart from these general precautions, no special measures seem to be called for at present, but a careful look-out should be kept for any future cases of disease or death thought to be due to *F. annosus* or *A. mellea*. Where centres of infection by one or both of these fungi are located in comparatively pure and isolated patches of deodar, silver fir or spruce, it may be necessary to take additional precautions, with special reference to these fungi, in the way of felling the infected trees with those immediately surrounding them and digging out and burning their stumps and main roots From the observations which I was able to make, it appears that the roots of spruce are sometimes killed, at least in the Deoban forests, by charcoal burning and this may facilitate the attack of a root fungus like *Fomes annosus*. It would probably be advantageous, in the future, to site the kilns near the somewhat less susceptible broad-leaved species rather than in the vicinity of conifers.

The most important practical measure of general application as regards the prevention of damage by root-attacking fungi, is to grow each species in the locality which suits it best and under the most favourable conditions of soil-moisture, soil-temperature and soil-aeration, so that all damage to the roots may, so far as possible, be avoided.

(v) Miscellaneous.

(18) Mr. Hira Singh, E. A. C. Forests, has drawn attention in his official diaries and elsewhere to an interesting point, *viz.*, that he thinks there has of recent years been an increase in the common leaf-and twig-attacking fungus of the spruce, called by the local villagers "red flowers of spruce," possibly as a consequence of short rainfall. The fungus referred to is probably chiefly *Barclayella deformans*, Diet. This fungus is more or less always noticeable on spruce and although it may no doubt be more prevalent in times of short rainfall, the evidence at present available points, I think, to the conclusion that in the present case, drought and sun-scorch are the primary factors to which we must ascribe the widespread mortality of spruce.

(19) In October, 1922, I noticed at Deoban the death of needles, twigs and occasionally of fairly large branches of silver fir, on what seemed to me to be a somewhat serious scale. From observations made in the forest, this seemed to be due to the local attacks of a needle-and twig-attacking fungus.

Specimens were sent to Kew and were reported on as follows: "the only fungus fructification which has been found on the dead needles of *Abies Pindrow* is a species of *Dimerium*", and the opinion was expressed that this fungus was not likely to cause disease. This is a matter which I think deserves further study.

(20) In conclusion, the writer desires to express his warm thanks to all those who have given material assistance in carrying through this investigation; to Mr. W. F. Perrée, C.I.E., for making the necessary arrangements for my tour, to Mr. F. K. Makins, Divisional Forest Officer, Chakrata, and Mr. Hira Singh, E. A. C. Forests, for giving me every assistance in the local forests; to Mr. R. N. Parker, F. C. H., who succeeded me in the office of Forest Botanist and who has invariably given every assistance possible in the way of sending specimens for identification, carrying on correspondence connected with the inquiry and otherwise; to Dr. C. F. C. Beeson, Forest Entomologist, for reporting on the insects

submitted to him and to the Director, Royal Botanic Gardens Kew, for kindly identifying the specimens sent to him. I desire also, particularly to acknowledge now the devoted service given to me in the field, during practically the whole of my service at Dehra Dun, by my Field Assistants Bisram and Jagarmani. In an especial degree, my thanks are due to Mr. Abdul Hafiz Khan, Assistant to Forest Botanist, who has been responsible for all the miscroscopic botanical work connected with this inquiry carried out at Dehra Dun, without which the investigation could not have been completed.

Finally, it is difficult adequately to thank Dr. E. J. Butler for all the help he has given me. In the Preface to my *Manual of Botany* (1909) I wrote " My special thanks are due to Dr. E. J. Butler, Imperial Mycologist of the Pusa Agricultural Research Institute, who has most generously allowed me to use his original work and drawings for the purpose of this book and to whose help the value of the portions dealing with fungi is entirely due." Since that date, Dr. Butler has invariably and generously given me every assistance in his power in connection with the study of the diseases of forest plants in India.

R. S HOLE C.I.E., I F.S.

Dated 4th March 1927.

A NOTE ON THE EXPLOITATION OF DAMAR PENAK IN THE FEDERATED MALAY STATES.

Compiled by J. G. WATSON, FOREST ECONOMIST, F.M.S

(*a*) *Introduction.*

1. This article deals with the establishment of a new industry in the Federated Malay States, and has been prepared at the request of the Editor. For the bulk of the information given the compiler is indebted to Mr. W. E. Kinsey, D.C.F., Negri Sembilan, and to Mr. E. A. Strouts, A.C.F., Kuala Pilah. It is hoped that the details will not prove irksome to the general

reader, and that they will be of some assistance to officers confronted with similar problems elsewhere.

2. The forests of Malaya are particularly rich in species that yield resinous secretions or *damars*, though comparatively few of them are known in trade circles The majority are produced by the family *Dipterocarpaceæ*, the many members of which make up the bulk of the growing stock and provide roughly 70 per cent of the timber at present regarded as utilisable within the Malay Peninsula.

3. The damar that forms the subject of this paper is produced by *Balanocarpus Heimii* King., a species of sporadic and somewhat local distribution known to the Malays as *penak* (pronounced " penna "), *chengal* or *chengai*. Both botanically and in the field the tree is easily distinguishable and it is, therefore, all the more remarkable that until a few years ago this species should have been confused with *B. maximus* King, a smaller, rarer, and entirely dissimilar tree.

4. In the lowlands and on ridges of the foothills where the soil is deep and well drained and where conditions generally are to its liking, *penak* attains huge dimensions, the largest recorded girth being a little above 40 feet, whilst clear boles up to 80 or even 100 feet are not uncommon. Foxworthy places the species fifth in order of abundance by volume, though only fourteenth by number of individuals amongst local timber producing trees. The wood is still generally (and until quite recently was officially) regarded as the standard timber for heavy structural work in exposed situations, for railway sleepers, and for boat building. Until it was demonstrated that equally good timbers were to be had, *penak* was almost always specified in contracts for works of any permanence, notably for railway construction throughout the F. M. S., with the result that the opening up of the country was accompanied not only by the destruction of many thousands of acres of forests to make room for the rubber planter and tin miner but by the systematic combing-out of the remaining accessible jungle to provide *penak* for maintenance and further construction. There are, of course, a number of equally durable timbers amongst

A typical *penak* (*Balanocarpus Heimii*, King) showing bole tapping. In spite of the large number of taps the health of the tree has not suffered.

the several hundreds of species that go to form the crop on any square mile of Malayan jungle, but this fact was not realised until the more accessible supplies of *penak* had been worked out or destroyed When, in addition, it was discovered that this tree produced a very high grade damar, there could be no doubt of the desirability of controlling its exploitation, and steps were taken to limit fellings except at the discretion of the Deputy Conservators. In one, at least, of the Unfederated Malay States it was sought to achieve a measure of protection by the imposition of heavy export duties on this particular timber and damar.

5. One of the chief obstacles to efficient protection lay in the admitted right of the Malays to take any kind of forest produce for their own domestic or communal use, and in the difficulty of persuading them that in cutting down *penak* trees to build their boats and houses they were depriving themselves of a useful source of permanent profit. In the State of Negri Sembilan it was found necessary to amend the Forest Rules so as definitely to exclude this tree from the general privileges granted under the Forest Enactment.

6. The position is now understood and generally accepted though there are still some who regard these protective measures as an unwarrantable interference with the liberty of the individual, and the departmental exploitation of damar as an unpardonable excursion on the part of Government into the sacred realms of private enterprise. Whether these charges are justified or not can best be judged from what follows.

(b) Uses.

7. Mr. Hedley Barry, in his recent work on natural resins* places *damar penak* amongst the "spirit varnish" resins, characterised by their complete solubility in alcohol and partial solubility in chloral hydrate. In this group he includes most of the Dipterocarp resins, the majority of which are, however, of dark colour and correspondingly less highly valued by varnish makers.

*The Chemistry of Natural and Synthetic Resins, Barry, Drummond, and Morrell, London, Ernest Benn 1926.

The finest and cleanest of all these is known as *damar mata kuching* (Cat's Eye Damar) the product of a number of species, the identity of which is still very imperfectly known.

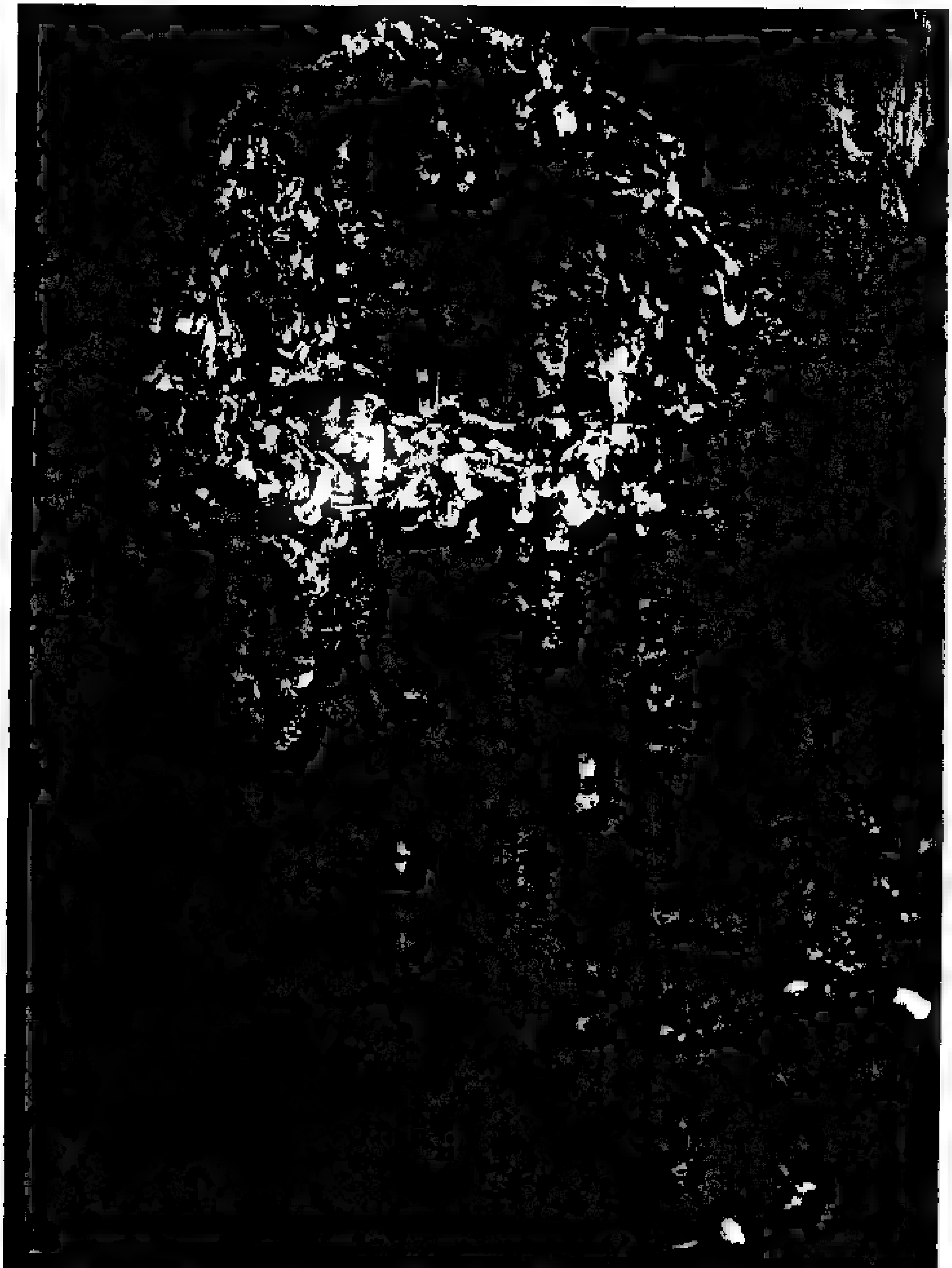
Damar penak and *damar mata kuching* are not infrequently confused, but the two are readily distinguishable by the stalactitic shape of the exudations of the former (Plate 17) as opposed to the globular form assumed by the latter, which also not infrequently has a peculiar greenish tinge. Although some of the trees that produce it (chiefly *Hopea* spp.) are not uncommon in the F. M. S. they do not react satisfactorily to tapping. Supplies are, therefore, irregular, and cannot be augmented by artificial means.

8. Resins of the *mata kuching* type mostly come from the Dutch Indies to Singapore where they are usually re-sorted and graded and finally marketed as Batavian and Padang damars. Singapore damar appears to be a rejection mixture of the two and to contain a considerable percentage of *penak*. Because of their paleness and lustre these damars are largely used in the preparation of paper varnishes.

For indoor use they compare favourably with Copal varnish but the final surface, though brilliant and adhesive, is softer and tends to be slightly tacky, so that they are not entirely satisfactory for outdoor work or for articles that require to be frequently handled.

(c) Reasons for Departmental Control.

9. Departmental exploitation of *damar penak* was first undertaken in 1922, following the interest in minor forest produce awakened by the Malay Borneo Exhibition held in Singapore in that year. This led to a closer examination of the forest produce that was passing through Singapore, and of the methods employed by the Chinese, who have practically the whole trade in their hands. It was found that considerable quantities of *damar penak* were being purchased from native collectors and sorted into grades which were based on appearance rather than quality, and in which the size of the fragments played a more important part than seemed either logical or desirable. A more serious fault lay in the use of the local damar to raise the standard of inferior resins from



A prolific tap, showing typical stalactitic exudation. (Para 7.)

neighbouring countries, with the result that it was practically unknown to the trade in its pure state. Consequently its true value had remained undiscovered.

10. Collection of minor produce in Malaya is carried out by the peasantry or, in the case of areas far removed from the villages, by aboriginal tribes commonly referred to as *Sakai* financed in both cases by Chinese shopkeepers. It is often a matter of comparative indifference to the shopkeeper whether or not he makes a profit on the forest produce which he is financing and for which he holds a licence from the Forest department. Of more importance to him is the profit that he makes on the supplies that he sells to the collectors and to the villagers generally the majority of whom soon find themselves in his debt. Credit for goods supplied is given on the strength of a promise, usually verbal, to replace them with their equivalent value in forest produce, and though there are, of course, a certain number of bad debts, the shopkeeper can exert considerable pressure by withholding supplies. His hold over the *Sakai* is not so strong, as they are essentially a nomadic folk, but their credit is correspondingly less, and they do not strike such a hard bargain as the Malays.

11. The small shopkeeper is usually financed by a larger merchant in the nearest town, who in turn owes allegiance to a yet larger one, and so on, so that the produce must pass through the hands of many useless middlemen before it reaches the shipper in Singapore. This "snowball" system of trading is practised throughout the country, and makes it very difficult to arrive at a true estimate of cost. Hitherto, from the point of view of the traders, it has been moderately successful, but increased prosperity has brought in its train a disinclination to indulge in a strenuous and often dangerous occupation in return for the pittance that the licencee is willing to pay, whilst improved transport facilities and the ease of obtaining employment elsewhere have increased the proportion of bad debts. Industries connected with minor forest produce are, therefore at rather a low ebb.

12. The only remedy for this state of affairs is the elimination of the useless middlemen to enable the payment of better

prices to the men who do the work. Exploitation of the ignorant peasantry by an alien race would, in itself, justify the intervention of Government. But when to this evil are added those of unsatisfactory marketing and grading methods and the destruction by indiscriminate and ruthless tapping of trees which produce not only a very valuable resin but one of the most prized of local timbers for heavy construction work, control by the Forest department becomes not only desirable, but imperative.

(d) Organisation of Departmental Control.

13. Having decided on the necessity for departmental action and received the necessary sanction of Government, care had to be taken that the collectors should not misunderstand the motives that prompted such a step. After reasonable notice had been given and active propaganda had been carried out in the localities where the industry was in being, no further licences were issued, and the collectors were invited to work for Government at a higher rate of pay than they had been receiving from their former employers.

Pessimists foretold the impossibility of continuance without adopting the system of advances to which the people were accustomed, but a firm stand was made against importunities of this kind, and the collectors accepted without much demur the substitution of cash payments for any quantity of damar, however small, brought in to reasonably accessible receiving stations.

14. Operations were first started in the Negri Sembilan, the smallest of the four States of the Federation, populated chiefly by early Menangkabau (Sumatra) settlers of an industrious type. The topography of this country lends itself admirably to the combination of rural and sylvan industries, the well watered valleys providing excellent conditions for the cultivation of rice, and the surrounding hills being covered with fine forest, with *penak* in more than usual abundance. Collection of damar had been going on for years, and many of the tappers had developed very considerable skill. Here, and nowhere else in the country the people realised the advantages of branch—as opposed to bole tapping—both as regards the quality and quantity of the resin.

15. The project was taken up with great enthusiasm, which was increased by the depression in the rubber and tin industries from which the country had not then fully recovered. The Conservator's annual report for 1922 records that the market for damar of all kinds was unusually high, and that although the output of *damar penak* had not been increased, its quality was admittedly far superior to any that had hitherto been seen in Singapore.

16. The example of the Negri Sembilan was followed by the other States, where efforts were made to organise the industry on similar lines. These, however, had not the same advantages of previous experience and a settled agricultural population skilled in tapping, and living in the heart of the *penak* country, so that progress was very much slower. It is probable that in the Upper Perak district of the State of Perak there are many more tappable trees than in the whole of the Negri Sembilan, but they are less favourably situated with regard to the settlements. The same disadvantage applies to the trees in Pahang whilst in Selangor and Southern Perak the development of other industries has been so rapid that the rural Malay population has dwindled to an insignificant figure. The only control exercised in the Unfederated States was in Johore, where a not very successful attempt was made to copy F. M. S. methods.

17. The rise in the price of tin and rubber that followed almost immediately after the establishment of this new industry proved a great hindrance to its further development.

Essentially accepted as a half-time occupation carried on in the intervals of rice cultivation, damar collection as a source of profit began to pale into insignificance beside the superior attractions of rubber tapping, and even the advantages of growing foodstuffs were not so apparent when it was possible, by working shorter hours than ever before, to earn enough to buy them. Consequently, the early enthusiasm waned, and it has not been found possible to do more than maintain the outturn from the Negri Sembilan. That from Upper Perak fluctuates very considerably. In other parts of the F. M. S. the industry failed to establish itself on a firm footing and is now moribund.

18. An attempt to introduce new blood into the business was made in 1924, when fifty families of Mendahilings were brought over from Sumatra and settled at Langkap, where each was given a small piece of land and promised $1 for every tree brought into bearing, in addition to payment at the usual rates for all damar collected.

This community forms a self-contained settlement under its own chief and may certainly be said to be prospering, though the looked for increase in the output of damar has not been achieved. The men have not proved as expert as was hoped and will not undertake the somewhat hazardous operation of branch tapping, with the result that the output per tree is lower than in the case of the skilled local men.

19 To maintain the output even at its present level it is necessary to employ an inspecting staff out of all proportion to the value of the damar collected, and it is becoming more and more evident that a solution will have to be sought in the employment of a full-time labour force working on monthly wages with a bonus on their collections. This would involve no breach of faith with the present tappers, whose trees will remain, for all practical purposes, their property, as long as they continue to work them to something like their capacity. The quantities that can be collected and the wages that could be earned by an able-bodied tapper are discussed in a later chapter. It may, however, be mentioned here, that where isolated Chinese have been induced to take up the work their earnings, although they tap only the boles, have averaged about three times as much as those of the *Malays*.

(*To be continued.*)

THE PROBLEM OF SAL REGENERATION WITH SPECIAL REFERENCE TO THE "MOIST" FORESTS OF THE UNITED PROVINCES

By F. C. Ford Robertson, I.F.S., Working Plan officer,
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1. The essential problem of sal is contained in the word "die-back."

The problem may be said to commence from the moment that the seedling radicle, drawing on its store of endosperm, penetrates the soil of the forest floor.

2. To have reached even this stage, it is true, other conditions must be fulfilled—one a factor outside of man's control, the other within it.

These require brief mention, not merely for the sake of completeness, but because of their influence on the details of management, as will be seen later. *They are, however, no part of the essential problem.* The conditions are :—

(*i*) *Fertile seed coupled with timely rain.*

Both these are, in the nature of things, large scale phenomena. Hence, when they occur together, there results a flush of seedlings over a wide area of country—a full "seedling" year as we may usefully term it. Such a happy combination, experience shows, may be expected only about once in every decade but partial and local seedling years are not infrequent.

(*ii*) *Removal of the dry leaf covering before seed-fall.*

This is conveniently and effectively accomplished by fire.

Two points are to be noted :—

(*a*) Sal with its peculiarly coriaceous leaf is its own worst enemy. Leaves of other species (except perhaps *Buchanania latifolia* and *Semecarpus anacardium*) offer far less obstruction to germinating seeds. It is constantly observable in dense unburnt sal forests that reproduction is found largely below patches of *Kokat* or in small blanks.

(*b*) Leaf burning is necessarily a speculative operation since timely rain cannot be predicted.

3. We now come to the problem ; what is the cause of die-back ? Hole has proved beyond doubt that it is due essentially to :—

Bad soil-aeration *alternating with and to a marked extent aggravating* a state of drought, the former phase being naturally most operative during the monsoon, the latter in the dry season.

4. But this is not sufficient Drought is a familiar enough conception, but what precisely constitutes "bad soil-aeration"?

This, indeed, touches the very core of the problem.

5. The investigation of ultimate causes is nearly always a difficult matter. In the complex bio chemical laboratory which we term 'soil," it is that and more. And it may well be doubted whether the ultimate analysis would assist us materially to a solution of practical difficulties. Our present knowledge, general and vague as it is, at least provides sufficient material on which to adopt a line of action.

Bad soil aeration is generally understood to connote—

(*a*) A deficiency of O_2 and excess of Co_2

(*b*) A large development of "reduction" bacteria, protozoa and certain forms of cryptogamic life.

(*c*) The production of "humic" acids.

(*d*) A degree of soil deflocculation

6. There is no reason to doubt the existence, in varying degree, of all these phenomena during the monsoon, the whole being conditioned, of course, by the long period of soil saturation. The presence of "humic" acids has certainly been proved and Hole demonstrated in addition that the sal leaf has peculiarly autotoxic properties.

7. How long such conditions outlast the rainy season is not known, but their duration, as also their intensity, must vary with the nature of the soil and the vegetation supported by it. On heavy ground, especially that subjected to constant trampling by cattle, the trouble may well be permanent.

8. In such an environment die-back would result from the wholesale death, or abortion of root-hairs and root-tip or, if sal, like so many European dicotyledonous trees, were proved to be physiologically dependent, impaired functioning of the mycorhiza would have a similar effect. The actual (proximate) attacking agent might be either chemical or organic in nature.

9. In any case the actual time and degree of die-back must largely be determined by :—

(*a*) The extent of the root-damage (itself dependent on the severity of the conditions obtaining).

(*b*) The intensity of the succeeding drought, and probably, if it varies much—

(*c*) The intrinsic vigour of the seedling.

10. Under extreme conditions, it is clear that death would be only a matter of time for all individuals,—some dying outright from inhibition of the radicle, others a little later from root-rot or mere inanition, and yet others in the ensuing dry season, due primarily to impaired functioning of the root system, —and so on in a cumulative, vicious cycle. Thus die-back may lead to die-out.

11. The inter dependence of bad soil aeration and drought is here clearly demonstrated. The one cannot be dissociated from the other. At the same time a feature of the relationship may with advantage be emphasised Drought cannot be considered here in its absolute sense. Its potency has always to be measured in terms of the opposite condition, so long as a vestige of that condition remains operative. Whether young sal is very resistant to drought *per se* may not be definitely settled: in a discussion of natural processes the point is academic.

12. So much for the "why" and "when" of die-back, as far as they seem to be known. What of the "where"?

The answer to that question raises a number of others, a joint consideration of which is essential to a true perspective of the problem.

13. We can approach the matter in this way. Die-back, in the first place, may be observed in every type of sal forest, on every type of soil. Now, if this process is readily understandable in, say, a dense Bhabar plateau (or *thapla*) forest, where during the monsoon even weed growth can barely subsist on the dark, dank forest floor, what of its occurrence on well-drained, open sites where not only weeds and grasses, but shrubs and such *kokat* species as *lasora* (*Cordia Myxa* syn. *C. obliqua*), *dhauri* (*Lagerstrœmia parviflora*) and *kachnar* (*Bauhinia malabarica*) appear to flourish and regenerate freely?

14. Looked at in this way, die-back gains a new significance. It would seem essentially a physiological, rather than a pathological process—the latter being commonly super-

imposed—and such a view is, if anything, strengthened by a consideration the truth of which few nowadays will dispute, *viz.*, that die-back, in greater or less degree, is universal—we may add inevitable—under natural conditions. It is not die-back, but the *absence* of it, that constitutes a phenomenon to be encountered perhaps, here and there amongst the seedlings of a new-forming "land slip* " forest.

15. There is confirmation for this theory in our knowledge of the artificial conditions necessary to eliminate die-back. These are of the most exacting kind. A species, indeed, which requires—

(*a*) Regular weeding.
(*b*) Full overhead light, and apparently—
(*c*) Hoeing or ploughing of the soil,

in order to develop "normally" (*i e.*, like say, a *chir (Pinus longifolia)* seedling) and yet at the same time is predominant over wide areas of country, forms ripe matter for speculation. Thus die-back possibly, is indicative of a process of adaptation to "new" and unfavourable climatic conditions, in especial the alternation of contrasting seasons which is so dominant a characteristic of the Indian climate in the present age. We might expect, then, that many, or most, of the associates of sal also die-back in varying degrees. This is a point yet to be investigated. If this is not the case, sal might be looked upon as a "recent ' (Eastern) invader, or more likely an old resident whose adaptability has become impaired.

Such are the more obvious speculations that occur to mind But we must return to practical considerations.

16. While systematic observation of die-back is still in its infancy, the effect of extremely adverse conditions has been forced on the notice of many, especially since the change to conversion. Thus the full seedling year of 1913 carpeted the forest floor in the Lakhmanmandi block of Haldwani division. In less than five years, 90 per cent. of the crop had disappeared for good, and

*See Indian Forest Record, Vol. X, Part III, page 34.

the rest was apparently dying. To-day survivors are often hard to find.

17. This, however, is a special case of the general proposition—otherwise advance growth would be a rarity indeed. In reality it is not so. Observation, confirming theory and experiment, demonstrates here the very marked influence of drainage. Other things being equal, reproduction is more numerous and more sturdy—

(*a*) On slopes than on the level.

(*b*) On the level than in hollows

(*c*) On a light soil rather than a heavy (but see footnote)*.

18. Illustrations of this abound.

Thus, in Haldwani division, on the rich moist loams of Lakhmanmandi, survivors of the 1913 seedling year are encountered chiefly on the small nala banks and undulations As the *thapla* begins to slope away southwards, reproduction becomes more frequent. Below the Chorgalia-Haldwani road, where the soil is shallower, lighter, and more stony, it is vigorous and abundant, and much of it can be referred to an earlier seeding year. On the extensive xerophytic *damars* (ravine-cut plateaux) of Jaulasal and Sudlimat—and this might be less expected,—reproduction is positively luxuriant. There is a similar object lesson on an extensive scale in the hill areas.

19. The above, however, is at best very general knowledge. It is qualitative, not quantitative. And we are viewing results rather than causes. Research can and must tell us more about the vicissitudes of die-back itself.

20. There is so much that it would help us to know about this period of struggle. Presumably it shows fluctuations (man's influence apart) according as the contrast of the seasons is accentuated or modified in any one year. Such fluctuations, it is reasonable to suppose, would be exhibited in ever-diminishing degree by the stronger and older reproduction, as the slowly deepening root-system won its painful way to the healthier and more stable con-

* In "heavy" areas the beneficial influence of clay, which retains near the surface much moisture during the growing period of sal, must not be overlooked.

ditions of the deeper subsoil. By a natural transition of thought we may further envisage the possibility of long periods of stagnation, during which neither progress nor retrogression occurs, vigour being maintained at a practically constant level. This phase is probably far more common and typical than we realise. Under very favourable conditions it may imaginably constitute a brief episode in the otherwise continuous development of the seedling.

21. We should also like to know, for each and every environment :—

(*a*) At what stage the critical period is put behind and eventual survival becomes a certainty.

This might be ascertained by subjecting reproduction of all sizes to the most adverse natural conditions possible to each habitat.

(*b*) Whether, when reproduction has reached this stage, it is necessarily, or ever, mature, *i.e.*, ready to put on permanent height growth and enter the sapling class.

More important—

(*c*) Whether we can always rely for our future crop on *one* full seedling year and one only.

And most important of all—

(*d*) What is the minimum period of die-back attainable?

This, we may be certain, will be one thing on moist *thapla* and, another in a xerophytic *damar* forest. The question, however, is too ambitious. In our present backward state of knowledge we may alter and simplify it to—

(*e*) How can we reduce the period of die-back?

22. This is a problem to a full appreciation of which what has already been written forms an essential prelude. Before proceeding, let us briefly recapitulate the main points of our thesis. These are :—

(*i*) Die-back in nature is universal and inevitable.

(*ii*) It is due to an essentially monsoonal state of bad soil-aeration to which the sal leaf is a contributing factor.

(*iii*) It is abetted by the succeeding dry weather.

(*iv*) Its severity is mitigated by conditions of good drainage.

23. Now what can be done under practical working conditions (to which many divisions are limited) to ameliorate the lot of young sal on each and every area?

24. Hole gave a lead by demonstrating that *a close-canopy intensifies both bad soil-aeration and drought, each in turn, by* :—

A.—So far as *bad soil-aeration* is concerned, minimising "run off" and evaporation, and increasing "drip," during the monsoon.

B.—So far as *drought* is concerned, intercepting dewfall and showers in the dry season.

25. Unfortunately, the opening of the canopy sees the clash of theory and practice. According to habitat, one of two things occurs:—

(*a*) In the drier sal forests there is a heavy production of grass.

(*b*) In the moister sal forests there is an almost immediate profuse development of weeds, which may become elephant high.

Under intermediate conditions both weeds and grass compete vigorously and tend eventually to establish themselves in gregarious masses.

26. As regards the dry forests, we know little for certain of the effect of this grass growth on sal reproduction. All the indications, however—in spite of the known toxicity of grasses—are of a favourable character. The lofty *Anthistiria*, for instance, appears to have no terrors for sal, which will regenerate in, and finally "come through," the densest masses. As an illustration may be cited the *chaor* along Chela 4 in Haldwani division, which is crowded with healthy sal reproduction in all stages, and it is significant that the trees from which the seed is derived are only in middle age. The grass here is burnt annually but this does not appear to affect the ultimate result, for at Durgapipal nearby, where the same phenomenon is observable, there has been no fire for over 40 years.

27. With some of the drier types of grasses, such as *Imperata arundinacea* and *Heteropogon contortus*, sal appears equally happy, but how far the list can be extended and a general rule established is still a matter for investigation. Actually, the question need not here concern us. Any substantial opening of the canopy is definitely barred by the grave fire hazard which would result. This paramount consideration, indeed, dominates the silviculture of these forests. There is seemingly little that can be done to aid nature during conversion, except in a negative way. Nature, fortunately for us in these areas, has a habit of helping herself. It is observable that a slow recruitment of sal is always in progress and this may largely save us from a dilemma—the necessity for leaf burning in localities where grass flourishes even under complete shade. For the rest, rigid protection from fire and from grazing, and the maintenance of a sufficiently close canopy would appear the sum-total of silvicultural enterprise.

28. We can now concentrate on the vexed question of regenerating the moist sal forests. The situation, affecting as it does all our most valuable crops, has become one of quite classic difficulty. It is no where more acute than in Haldwani, where "anticipatory" conversion fellings have proceeded longest and farthest, and where ripeness for the axe all too seldom connotes an abundance of reproduction.

But we must come to details and review the whole process.

29. It is observable that every forest, even the densest and moistest, carries a certain quota of shade-bearing weeds. Their sparseness, indeed, under the suppressed conditions of a heavy canopy is often more apparent than real: sometimes despite complete shade, they form a dense growth. Amongst these weeds may be mentioned *Clerodendron infortunatum* and *Pogostemon plectranthoides* and, of less importance, *Colebrookia oppositifolia* (*binda*) *Adhatoda Vasica* (*bansa*), *Helicteres Isora* (*marorphal*), and *Callicarpa macrophylla* (*dhaia*). The commonest and by far the most noxious, however, is *Clerodendron*. Tolerant to a wide range of soil conditions, seeding regularly and abundantly in all but the densest shade, it is a vigorous coppicer and carries at all times a heavy leafage. *Pogostemon*, its chief associate, is less hygrophilous, has

less vigour of growth and a much lighter leafage, which, moreover, thins perceptibly during the growing season of sal. In the United Provinces at least, the undergrowth problem is essentially a *Clerodendron* problem and measures successful against it may for the present be taken to apply *a fortiori* to its less vigorous associates.

30. As is well known, when the canopy is opened in any area this stock of weeds receives a powerful stimulus, alike to growth and to multiplication, and any previous gaps rapidly fill up. The effect of this on sal reproduction requires little stressing. Admission of light to the soil is at best very temporary.

For the former condition of—

(*a*) A high, complete, canopy.

(*b*) A suppressed underwood.

(*c*) A fairly sparse undergrowth

there is substituted –

(*a*) A high broken sal canopy.

(*b*) A stimulated underwood.

(*c*) A dense low non-sal (weed) canopy,

and these in combination clearly result in—

(*a*) Much greater shade (even productive of etiolation).

(*b*) Less circulation of air.

(*c*) Increased competition for water in the dry weather and probably little diminution in the interception of rain, against which, as a negligible offset the meticulous might record

(*d*) A humus of reduced toxicity, since there are fewer sal trees in the overwood.*

Under such conditions it can scarcely be doubted that the sal is even worse off than before. Experience in Lakhmanmandi and elsewhere indicates that, following a short-lived and misleading access of vigour, reproduction of all sizes commences to decline or at best makes no appreciable progress.

31. Our remedy, in short, appears worse than the disease, directly aggravating it.

*On the other hand the mass of weeds may secrete considerable quantities of toxin.

What is the way out of the impasse? There is only one that we know at all practicable *—the use of fire.

32. Fire, if a bad master, is a most useful and cheap servant to the silviculturist and one whose potentialities have not perhaps been fully realised. The employment of fire to remove the obstructive (and, incidentally, toxic) leaf layer was mentioned at the outset. We now come to its second and no less important function—the burning of the weed undergrowth.

33 This is a comparatively recent use of fire and its full possibilities and limitations are still in process of discovery.

We can summarise the available knowledge as follows:—

(*a*) Fire can kill back all species of weed growth.

(*b*) If the canopy is fairly intact, the succeeding year's growth shows distinct weakening.

(*c*) The more open the canopy the longer does this weakening effect appear to be delayed.

(*d*) Repeated burning causes the production of grass at the expense of weed growth.

(*e*) In the underwood only the smaller branches of the hardier species such as *rohini* (*Mallotus philippinensis*) are killed but a combination of burning and cutting back is likely to be efficacious.

34. So much for the direct results. But this burning has a most important secondary influence on weed growth. The commoner and more dangerous weeds (*Clerodendron, Pogostemon, Colebrookia*) *are destroyed in their flowering season* and so cannot produce seed. Continued burning, therefore, especially on a large scale, performs a service the importance of which demands fuller recognition. It cannot be doubted that prior to the era of successful fire protection the undergrowth, and in especial *Clerodendron*, was both localised and suppressed. Centres of dissemination would be comparatively few—being confined, in fact, to areas which had escaped fire for several years—and the pernicious *Clerodendron*, at least, with its large, heavy berries, would have little chance of spreading; certainly less so than *Pogostemon* or *Colebrookia*, the seeds of which are light and wind-borne.

* See in next issue, para. 65 (iv).

35. Fire-protection, in short, may be conceived as having established an entirely artificial condition of affairs, one which in these moister tracts weighs heavily against the very species it was designed to assist. It seems clear that repeated burning, in moderate shade, of all weed-infested areas will eventually restore the local balance of nature and stamp out what is nothing short of endemic disease. We may, indeed, confidently look forward to a time when heavy opening of the canopy in anticipation of a seedling year will be an operation attended with little weed-hazard.

(To be continued.)

THE FINANCIAL RETURN FROM THE CULTIVATION OF SCOTS AND CORSICAN PINES.

BY W. E. HILEY (OXFORD FORESTRY MEMOIRS, JUNE, 1926. PUBLISHED AT THE CLARENDON PRESS, OXFORD, PRICE 3*s.* 6*d.*)

The Oxford Forestry Memoirs though still few in numbers have dealt with a remarkable range of subjects all bearing on forests and forestry such as physiology, soil science, fungoid diseases, measurement of tree crops and ecology ; the present number adds to the list the little understood topic of forest economics. It appears from the treatment that Mr. Hiley's interest is to see what can be made out of an intriguing mathematical problem rather than to give a conclusive answer to it and his method is the obvious but laborious one of listing the variables likely to affect the result most radically, determining the probable range of variation for each, and working out the "financial return" (more usually known as the mean annual forest per cent) for selected typical combinations. Three of the variables, cost of land, cost of planting and cost of maintenance are not difficult to deal with their range being well known. (In view of our ever extending plantation work in India it may be noted that the latter two items are taken as Rs. 65 to Rs. 90 per acre and Rs. 8 to Rs. 5-5 per acre per annum). More difficult is it to deal with the question of future prices. The author gives grounds for anticipating a steady annual rise of 0·9 per cent in timber prices *relative to general prices*, but perhaps lacks the innate sporting proclivities required for an attempt to forecast future movements of general prices, not that these would necessarily and fundamentally upset his calculations, which are made assuming annual price increases nil, one *per cent* and 1½ *per cent.*

It is shown that even under the most favourable combination of circumstances considered reasonable, Scots pine crops can never yield 5 per cent if one has to pay by no means a high figure of £2 per acre for the land. About 3 or 3½ per cent. may be expected with all factors at average values.

As regards the relative merits of the much faster growing Corsican pine an *impasse* is virtually reached, for the only avail-

able yield tables are provisional and incomplete and none knows the proper price and present value of the timber, let alone the future figures. Guessing these data, it appears that it would be more profitable to grow Corsican than Scots pine provided cubic foot prices for the former are not more than 40 per cent. lower than those for the latter.

An interesting side issue is an examination of the sum one could profitably spend on improving the quality of the locality, and the calculations show that an outlay would be justified to £8 per acre on land costing £2 per acre to effect an improvement from Quality II to I for Scots pine, or one of £11 in bringing Quality I Scots pine to Quality II larch.

Looking for opportunities for utilising this study in Indias we are handicapped by the fact that the only money yield tables we have at present are Bourne's for Nilambur teak. These are now generally considered to be unduly optimistic, and it may surprise some readers to know that using them as a basis it would be permissible to spend upto Rs. 800 per acre on establishing an acre of Quality II teak plantation ! The question often arises of the relative value of teak and such species as *Gmelina arborea* for plantations and *taungyas*, but volume increment data for these are far more scanty than for Corsican pine. Money yield tables could now be made for several of the North Indian species for which good volume yield tables are available, but this has not been done so far.

The memoir is nicely printed on good paper unlike so many of our Indian official publications nowadays. The only errors noted occur on the middle of page 11 (third *para.*) where the figures differ slightly from those given in Table I from which they are presumably taken.

In conclusion, we welcome this study as demonstrating methods of analysis and particularly for the support it gives in bringing out the great importance and profit of the amelioration of locality, quality and conversely the losses consequent on allowing quality deterioration.

H. G. C.

THE FLORA OF WEST TROPICAL AFRICA.*

The first portion of a flora for West Tropical Africa by Hutchinson and Dalziel has been issued by the Crown Agents for the Colonies, 4, Milbank, Westminster, London, S. W 1, at 8*s.* 6*d.* Hitherto the only work dealing with this area has been the Flora of Tropical Africa. This work is now almost complete but as Vol I was published in 1868 the earlier volumes are quite out of date Vol. III appeared in 1877 and then there was a long interval until 1898 when Vol. VII appeared The Flora of Tropical Africa, therefore, when finished will not be a satisfactory work. The defects in it are due to the vast area it was intended to cover and the incomplete botanical exploration of the area at the time the work was started. In the family Anonaceæ for example the Flora of Tropical Africa describes 59 species belonging to 13 genera whereas in the present flora in spite of the very much smaller area covered 98 species in 20 genera of Anonaceæ are described.

The flora is prepared upon the "Key System" which has the advantage of saving space and if it saves time in the completion of the work this is a further advantage. Nothing else can be said in favour of the Key System. A local flora is supposed to bring together the descriptions of the plants of a restricted area which are only available in numerous journals, monographs and similar publications which are seldom found complete in any library. A flora on the Key System fails to do this since on the plea of saving space the specific descriptions are omitted. On the other hand the descriptions of the families and genera which are available in standard works are printed in full. The Key System flora, therefore, saves space in the place where space should not be saved and fails to save space by the adoption of keys in place of full descriptions of family and generic characters.

The classification adopted is very interesting when expounded in special articles in the Kew Bulletin but is out of place in a work intended to facilitate the identification of a plant. Most users of floras are not trying to learn the latest ideas as to the phyllogene-

*Flora of West Tropical Africa by J Hutchinson, F.L.S , and J. M Dalziel, M.D., B.Sc , F.L.S , Vol 1, Part I The Crown Agents for the Colonies, 4, Milbank London, S.W , price 8*s* 6*d*

tic sequence of families and if the system of Bentham and Hooker or that of Engler cannot be adopted they would find it more convenient if the families were arranged in alphabetical order. A new system of classification is perhaps very desirable but a standard sequence of families should first be agreed upon. The users of floras are entitled to protest if every flora is intended to advertise some special ideas as to evolution. The flora of Jamaica, for example, now in course of publication at a rival institution advertises a somewhat different sequence of families.

The flora is well printed and illustrated by numerous excellent line drawings.

R. N. P.

EXTRACTS.

THE HIMALAYAN SILVER FIR AND AEROPLANE CONSTRUCTION.

An important communication (Indian Forest Research Institute Bulletin No. 69, Economy Series, 1926) has recently issued from the Forest Research Institute at Dehra Dun, India, dealing with "The Mechanical and Physical Properties of Himalayan Spruce and Silver Fir." The work of the various branches of the Research Institute is laid down on a triennial basis, lines of investigation to be undertaken being entitled "projects." The present bulletin refers to timber testing work under Projects Nos. I and II on *Picea Morinda* and *Abies Pindrow*.

These two species have been sparsely utilised by the markets up to date owing to costs of extraction and a lack of knowledge as to the properties of the timbers. They exist in large quantities in northern India. Spruce is found in the Himalayan tracts from Afghanistan to Kumaon, from 7,000 ft. to 11,000 ft. elevation, and commonly mixed with fir, deodar and *Pinus excelsa*. The silver fir extends from Afghanistan to Nepal, from 7,500 ft. to 11,000 ft. sometimes as pure crops but commonly mixed with spruce, deodar and *Pinus excelsa*, and at times associated with broad-leaved species. It is estimated that existing mixed spruce and silver fir forest could supply a sustained annual yield of more than two million cubic feet, the best localities being enumerated. Both species grow to a large size. Himalayan spruce are reported up to 215 ft. in height and as much as 23 ft. in girth, whilst the Himalayan silver fir has reached a size of 202 ft. in height and 26 ft. in girth.

The investigations carried out in the Timber Testing Branch of the Institute were undertaken in order to ascertain the strengths of the two timbers for constructional, aeroplane, and other

purposes. Incidently, the question as to whether the spruce red wood was inferior to spruce white wood was decided. The impression that such is the case is commonly held. The investigations showed, however, that the red wood, which is simply the darker, denser material near the centre of the lower portion of the tree trunk, is in no way inferior to spruce white wood when taken from healthy living trees. The tests have demonstrated that the timber of silver fir has proved to be stronger than the spruce, which is also the case, in some parts, with the European species of these genera. Apart from its scientific aspects, the bulletin has both a commercial and Empire value owing to the deductions derivable from the tests.

The two principal causes which have led to complaints, both from the match manufacturer and others, and to the restricted use of these two conifers in India, are the prevalence of knots and the lack of durability of these timbers. The comparison has usually been made with some of India's most valuable timbers, such as deodar, teak, *Xylia dolabriformis*, and so forth A similar comparison in Europe would be to contrast silver fir and spruce with oak. The tests have shown that the Himalayan spruce and silver fir are at least as durable as and stronger than the corresponding species of Europe and America. The investigations carried out were made on similar lines and are strictly comparable with the results obtained in the Forest Products Laboratories both in Canada and the United States. The Himalayan silver fir has been proved to be stronger than Sitka spruce (*Picea sitchensis*), the accepted conifer for use in aeroplane construction It is held that the Himalayan species are not more knotty than the spruces and firs of other parts of the world, with the exception of the Sitka spruce. The tests have shown that the silver fir is less knotty than the spruce in the Himalaya, and a case appears to have been made out for a careful survey of the denser older forests of the former species with the view of the possibility of their being able to furnish aeroplane material.

It is a common British failing to suppose that the foreigner has a better article than can be produced in the Empire, so this careful piece of research work deserves to be widely known. For

the time is assuredly approaching when the silver fir and spruce belt of the western Himalaya will furnish its quota to assist the rapidly dwindling soft-wood supplies of the globe.—[*Nature, 14th May 1927.*]

GIANTS OF THE FOREST.

THE TALLEST TREE.

(MR. LANE-POOLE'S INVESTIGATIONS.)

The question as to what country contains or has produced the tallest trees has been the subject of much discussion in Australia and other lands during the last five years.

Doubt existed for considerable time amongst forestry officials and timbermen as to where the tallest trees were to be found; and many statements, official and otherwise, differed widely as to the heights.

Interest in the subject was heightened by the publication of statements made by Mr. Owen Jones (at the time Forestry Commissioner of Victoria), and republication of a report submitted to the Western Australian Crown Lands Department more than thirty years ago by Mr. F. S. Brockman, then Chief Surveyor in that State.

Australia, at least, had no data upon which it was felt the issue could be confidently decided.

Soon after his accepting office as Chief Forestry Adviser to the Commonwealth Government, Mr. C Lane-Poole (who personally believed that Australia had not the tallest trees in the world) engaged in correspondence with the large organisation in Berkeley, California, known as the Save-the-Redwoods League, and asked also for records from the forestry departments of the various States of Australia with the view to determining the question.

From California it was ascertained that Mr. David T. Mason, of Portland, Oregon, forestry engineer, had, with representatives of the Pacific Lumber Company, at Scotia, California, during last winter, measured a number of redwood trees. In a memo. to

Mr. Newton B. Drury, Secretary of the Save-the-Redwoods League, Mr. Mason stated that a tree on North Dyerville Flat in the redwood region, was found to measure 346 feet in height, and 15·1 feet in diameter at 4½ feet from the ground. Of another locality (Bull Creek Flat) it was stated that the party there measured a tree that had been previously measured with a Brunton pocket compass and transit. "My former measurement, made 6th March, 1926," the writer explained, "gave the tree a height of 375 feet. When measured with the transit on 28th March, however, the measurement taken from one direction was 359 feet tall; when taken from another direction it was 368 feet tall. There was much difficulty," Mr. Mason added, "in measuring this particular tree, because we had to get rather close to the base to see the top. Therefore, the measurements are much less reliable than in the case of the tree on North Dyerville Flat. This tree has a diameter at breast height of 12 feet, it is 185 feet from the ground to the first small branch, and 205 feet from the ground to the first large branch."

Other redwood trees were measured. The measurements made of individual trees were in the following order:—346 feet, 326 feet, 324 feet, 338 feet, 337 feet, 331 feet, 302 feet, 320 feet.

Mr. Newton B. Drury (27th February, 1926) reminded Mr. Lane-Poole that the accepted fact, from actual observation of timber cruisers, was that specimens of the *Sequoia sempervirens* or Coast Redwood) sometimes attained a height exceeding 375 feet, which would "apparently make the redwoods the tallest trees in the world."

From reports made by all the forestry services of the States of Australia, Mr. Lane-Poole doubts whether this country has to-day any trees 300 feet or more in height. New South Wales had trees not as tall as trees in Victoria; and it has been questioned whether the latter State has many much higher than 250 feet. One *Eucalyptus regnans*, at Colac (Vic.), was 347 feet, and another of the same species was measured by a Government surveyor as 375 feet, but both have been destroyed.

Queensland had no trees taller than those of Victoria,

Western Australia possessed a Karri *(Eucalyptus diversicolor)* that measured 278 feet. There may be taller trees, but it is doubtful whether there is any tree as tall as 300 feet.

South Australia cannot do better than 150 feet. Tasmania has no height records, but probably she has trees as tall as any in Western Australia.

The New International Encyclopædia (U. S. A.) had it in 1925 that the eucalyptus tree of Australia was the "tallest growing thing in the world," and that "one individual tree 475 feet in height had been found." Mr. Lane-Poole advised that these figures should have been "278." The tree was a Karri.

Research work in connection with the redwood trees of California about this time made local organisations curious to obtain the correct data as to the alleged supremacy of both the redwoods and the eucalyptus trees in the matter of height. And Mr. Ralph Townsend, of the Save-the-Redwoods League, wrote Mr Lane-Poole for authoritative measurements of the tallest Eucalyptus in Australia. The League had had accounts of "fabulously high eucalyptus trees," but Mr John Muir, who had visited Australia especially to investigate the reports, had advised the League that the eucalypts did not average as high as the redwoods by 50 feet or more, though a comparison was not made between the extremely tall individual trees of the two species.

Mr. Townsend was unable to say just how high the tallest redwood was, as the denseness of growth around the taller trees precluded accurate measurement; but there were a few trees in Humbold county approximating 380 to 390 feet, and in his opinion the maximum height of redwoods anywhere did not much exceed this figure, if at all.

An interesting statement as to the reported tree-height of 475 feet credited to Tasmania, and quoted by Mr Townsend, was made by Mr. Stubbs, for the Tasmanian Conservator of Forests, who expressed the belief that the figures had been inserted by an officer, since deceased, in a booklet published for a Hobart firm of merchants twenty years ago, when there was a great boom in hewn timber for harbour works, and that this statement of tree-height was without foundation.

Recent measurements give 300 feet as the tallest tree in New South Wales (*Eucalyptus viminalis*, Tumut district); 326 ft. 1 in., the tallest in Australia (*E. amygdalina regnans*, spur of Mount Baw Baw, Gippsland Victoria); and 390 feet the tallest in the world (Redwood, *Sequoia sempervirens*), California.—[*The Australian Forestry Journal, 15th January 1927.*]

THE KANJIKOD MATCH FACTORY.

The Kanjikod Match-factory satisfies all the conditions necessary for success, it is situated near both private and Government forests, whence a continuous supply of green timber can be had easily at small cost. It enjoys a dry climate throughout the greater part of the year except for a few months in the rainy season when the works are working full time. The proximity of the railway greatly helps in keeping down the cost of the production

*Bombax malabricum** is the principal wood used in this factory as it is found there in great abundance and has not a ready sale in the market. Logs are transported from the forest with their bark on in order to prevent quick drying. The bark is peeled off before use and the log is cut into lengths of one foot for making box veneers, the girth of the log being 18 inches, which is found to be most convenient. From practical experience, trees from 10 to 15 years are well suited for match boxes and those from 15 to 25 years for splints. If the wood is very soft, the surfaces of the veneers are not smooth and hence the inner soft portion of the billets is rejected.

This industry can be divided into two broad sections, *viz.*, (1), processes for manufacturing the splints, veneers for boxes, methods of drying sieving, polishing, etc, and (2), processes for dipping and the final pasting up of the boxes.

At the Kanjikod match-factory, where dipping and pasting up of the boxes are not done, the following machines were found

*This and *Bombax insigne* were found eminently suitable for both box and splints. *Spondias mangifera* proved very suitable for splints. *Alstonia scholaris*, *Odina Wodier* and *Garuga pinnata* were tried but found to be not so good as Bombax. *Melia composita* and *Ailanthus excelsa* were found to be fairly good for splints though not for boxes.

to play an important part in making splints, veneers, sorting out of splints, polishing, etc

(a) Veneer cutting machine: for peeling veneer for boxes.

(b) Chopper: for making splints.

(c) Cutter: for cutting the prepared veneers to proper sizes.

(d) Sieve: for sorting out the splints.

(e) A polishing drum.

Veneer cutting machine.—It has a knife edge which cuts off very thin continuous pieces from the block of wood which rotates on its longitudinal axis. The knife is automatically brought nearer and nearer as the wood gets thinner and thinner. As soon as the hard portion of the block is used up, the block is taken away. When the veneer is being made (peeled) the places at which it is to be folded are also scored by adjustable pins. These veneers are then finally cut into convenient sizes, dried and packed up.

Chopper.—In this splint cutting machine, rectangular blocks of wood roughly 9″ × 5″ × 5″ are used. The blocks are first cut into small planks 1/10th of an inch in thickness by a knife attached to it. These planks are again cut in the same machine, each stroke of the knife produces 800 splints. These are then dried and bleached in the sun for two hours.

Sieve.—These splints are then put into a rotary machine of wire netting. When the drum is revolved the required splints come out and the waste ones remain inside. These selected splints are then put into another machine of the same kind, which, when made to revolve polisnes the splints by rubbing them one with another. Finally they are dried and packed up.

In this factory three different kinds of splints are made with their necessary boxes. 144 of such boxes cost only four annas.

The machines are worked by a steam engine. Small boys are employed in the routine work, firstly, because the poor boys are benefited with the work and secondly, because the proprietor gets the work done at the cheapest possible rate.

Every individual in India, on an average, uses three to four sticks per day, and at this rate, quite a large number of factories

are required to supply the demand. For this industry, India has yet a vast field and if capable men take up the management, she will not only make her own supplies but will also compete with other countries.

R. B. GUPTA,
Student, Madras Forest College.

[*Madras Forest College Magazine, September 1926*]

FOREST GRAZING.

"THEY DON'T MIX."

The man, who likes a good tree stand
Should not use woods for grazing land
A real good gardener sometimes can
By being careful of his plan
And going to some extra trouble
Make one small space do duty double
Have parsnips close to spinach greens
And sweet corn interrowed with beans
According to Professor Cope
Who writes our college forest dope
For pastures and for growing wood
This double use is not so good.
The soil throughout the forest tract
By trampling feet is tightly packed
No longer fit for good tree seeds,
It nurtures only brakes and weeds.
The Oak that fain would reproduce
Says " My good gosh, it ain't no use
Behold each seedling of my heart
Chewed off before it gets a start"
The moral's pointed pretty slick

Within a well-known Limerick
" A smiling young lady of Niger
Went out to ride on a tiger.
They came from the ride
With the lady inside
And the smile on the face of the tiger."
The trees are sad where cattle browse ;
The smiles are all upon the cows.

PROF. R. M. ADAMS,
(*Forest Protection Conference Papers,*
Syracuse University, U.S.A.)

THE AMERICAN BISON : A QUESTIONABLE EXPERIMENT.

BY DR. JAMES RITCHIE.

Thirty-eight years ago the sum total of American bison had been reduced from the millions of a century earlier to a number estimated by Hornaday at 1091, and there was a prospect that the species might become extinct. The situation was saved by the action of the Governments of the United States and Canada each of which placed remnants of the dwindling herds under protection in large reserved areas. The rapidity with which the protected animals recuperated is well illustrated by the history of the Canadian herd. In 1907 the Dominion Government, acting through the Department of the Interior, purchased the 709 members of the herd owned by Michael Pablo of Montana, which can be traced back to four wild calves captured by an Indian in 1873. By 1909 the Pablo herd had been set at large in the Buffalo National Park at Wainwright, an area 15 miles long and 13 miles wide, and in 1925 this herd was found to number approximately 12,000 head, the increase in 16 years being about 11,300. The future of the species in Canada therefore, seems to be assured. So far, the success of the experiment of protection has been all that could be desired.

A new difficulty now faced the authorities in Canada. The area of close on 200 square miles set aside for the original herd was insufficient to support the new numbers, and some method of reducing the numbers and of disposing of the annual increase had to be devised Some 2,000 have been slaughtered for food and robes, some have been transferred to other parks, including a pair sent to the Scottish Zoological Park in Edinburgh and more than 1 600 have been transported northward for 700 miles to Wood Buffalo Park in the North West Territories The Wainwright stock now reduced to about 8,000, or about one to 16 acres, must be still near the food limit of the area (ten acres to one sheep is a rough guide to the food capacity of Scottish mountain pastures), but arrangements are being made for the disposal of the annual increase, which in the full herd amounted to 1,500 individuals a year. It is, however, to the transference of large numbers to Wood Buffalo Park that attention is here particularly directed.

The Department of the Interior is to be congratulated on the success of the work of transference; for, by means of specially designed car and barges, 1,634 bison were moved by rail and water for 700 miles with only 8 casualties But the transference gives rise to some doubt from the scientific point of view.

In Wood Buffalo Park there existed the only herd of wild bison which has survived, and these, the "wood buffalo," have been separated from the "plains buffalo" of the reserves as a distinct race, *Bison, bison athabascae*, characterised by its larger size, darker colour, more dense and silky hair, and larger and more incurved horns Whether these characters are due to innate variation emphasised by segregation, or are simply the evidences of the effect of a different environment, is not known. At any rate, this race has now little likelihood of survival as a pure strain, for amongst its members, which probably do not exceed 1,500 in number, have been deposited 1,600 individuals of the contra-distinctive race of the plains and the wardens report that "the plains and the wood buffalo are mingling freely and that there is every prospect of the complete amalgamation of the two herds."

From the scientific point of view the opportunity of making an interesting experiment has been missed. Had the surplus

plains buffaloes been deposited in an area similar in latitude, vegetation and climate to Wood Buffalo Park, but isolated from it, instead of in the Park itself, the wood buffalo race would have remained uncontaminated, and time would have shown whether in the new environment the plains buffalo would have assumed the distinctive characters of the wood buffalo. Had it turned out that these characters were wholly environmental, as they may well be, an interesting biological correlation would have been proved, and no objection could then have been taken to fortifying the wood buffalo herd by the addition of plains individuals

In the meantime two suggestions may be made. First, in view of the possible swamping and disappearance of the distinctive wood buffalo as the result of crossing, it should be assured that several pure-bred typical specimens of that race find a place in one or more of the Dominion or other great museums. Secondly, if it be possible, the next batch of surplus plains buffaloes to be transferred from Wainwright should be placed in a northern area other than Wood Buffalo Park, with the view of establishing a new and independent herd in which the influence of climate might be watched. The result would finally condemn or vindicate the 1925 experiment of commingling the racial forms.

(*Nature, 20th February 1926.*)

O LEARY AND CO.'S LONDON MARKET REPORT.

EXTRACTS FROM THE REVIEW OF THE YEAR 1926.

At the end of 1925 there were signs of better general trade and 1926 opened in the timber trade on a fairly cheerful note. The impending trouble in the coal trade, however, soon began to throw a shadow over business in general, and as soon as the strike, reinforced, by the short-lived general strike, materialised, all hopes of good business for timber trade vanished. It is true that as the strike began to wane in the latter quarter of the year and it became obvious that a settlement could not be much further delayed, business began to revive, but the damage caused has been too serious and too widespread for consumption to resume

fully this year. It is satisfactory, however, that one of the principal factors necessary to a trade revival is present in the confidence, which is fairly general, that the way is now clear for business, unhampered by the fear of further similar cataclysmic disturbances for some time to come.

East India teak.—The following are the statistics for the last three years :–

		1926. Loads.		1925 Loads.		1924. Loads	
		Timber	Planks	Timber.	Planks.	Timber.	Planks
Imports ...	Moulmein ..				..	..	
	Rangoon	4,238	1 423	5,481	2,096	2,395	989
	Bangkok .	1,045	644	760	759	483	195
	Java, etc. ..	28	26	29	56	78	14
	Total	5,311	2,093	6,270	2,911	2,956	1,198
Deliveries ...	Moulmein .	..	..	...	..	38	..
	Rangoon .	3,009	1,868	4,776	1,776	2,290	1,588
	Bangkok ..	526	644	726	453	901	686
	Java, etc. ...	13	33	84	41	11	20
	Total ...	3 548	2 545	5 586	2,270	3,240	2,294
Stock, 31st December	Moulmein ..	.	...	.	..		
	Rangoon ...	2,294	1,227	1,065	1,672	360	1,352
	Bangkok ...	683	1,105	164	1,105*	130	773
	Java, etc. ...	36	24	21	31*	76	8
	Total	3,0[illegible]3	2,356	1,250	2,808	566	2,133

Although during a portion of the strike period English buyers were not competing for supplies, the demand from other sources was sufficient to keep the market steady, and even firm, under existing conditions of short supply. With the exception of the short period above referred to, the demand for teak, especially conversions, has shown remarkable vitality, and the upward trend of prices, which was first noticeable in 1924, has continued. It is to be hoped that they do not reach a prohibitive figure, but it seems

*Stocks corrected

an established fact that the peak of production has been reached and in the near future a further rise in values appears inevitable in view of the quantities already sold for future delivery and the further quantities estimated to be required to meet the prospective demand of the near future For any easement of values, therefore, we must look to a smaller demand but we can hardly expect more than occasional and temporary relief by this means, unless the estimates of forest outputs have been seriously understated.

Timber.—Imports have been less than those of 1925 by 15 per cent., but consumption has been much lower, with the result that stocks are heavier than at the same time last year by 140 per cent. This is probably only a temporary feature and is not surprising in view of the short time work and even partial or total closing of factories and carriage works through shortage of fuel. The result, however, has been a considerable reduction in forward sales, but this has not had much effect on quotations, as shippers generally have sufficient orders on their books to absorb current supplies, and any further contracts which they could take would be for fairly extended delivery, by which time it is reasonable to suppose the demand will have revived

Planks and Conversions There has been a well-sustained demand throughout the year, foreign enquiry having come in to replace that from the U. K. during the short period when the latter failed as a result of the coal strike. The quick revival and sustained strength of the U. K. demand, however, have been a feature of the market. Prices have hardened steadily throughout the year and are now about 10 per cent. higher than at the end of 1925.

Java teak.—There have been isolated imports of hewn logs and flitches, but the demand still continues very small

Padouk. The demand has left much to be desired and progress with the landed stocks has been slow. It does not seem as if market prospects justify an extensive forest exploitation for the export trade at present.

INDIAN FORESTER

OCTOBER 1927.

A NOTE ON THE EXPLOITATION OF DAMAR PENAK IN THE FEDERATED MALAY STATES.

(COMPILED by J. G. WATSON, FOREST ECONOMIST, F.M.S.)

(*Continued from pages* 493—500, *September issue*).

(*e*) *Tapping and Collection.*

20. There are, of course, slight variations in the organisation, of different localities, but the procedure adopted in the Negri Sembilan is applicable to all Would-be tappers obtain authority to work from the Forester in charge of the division.

About thirty trees are allotted to each tapper, this being the maximum number that can be dealt with by one part-time worker

These trees are then identified by means of zinc plates bearing serial numbers surmounted by the tapper's licence number.

When this has been settled, the tapper is provided with a chopping knife (*parang*) or an axe (*beliong*) on which is stamped the number of the division, the tapper's number, and the first and last numbers of his trees, *e.g.*, V,18,1/29. The knife or axe forms his authority to work those particular trees and provides him, in addition, with an adequate tapping implement.

21. Trees do not respond to tapping at once, and they vary very considerably in their yield. It is usual, therefore, for the early operations to be subsidised by the payment of a fixed rate per tree or per tap, the latter being the more convenient method, as the number of taps varies, of course, with the size of the tree.

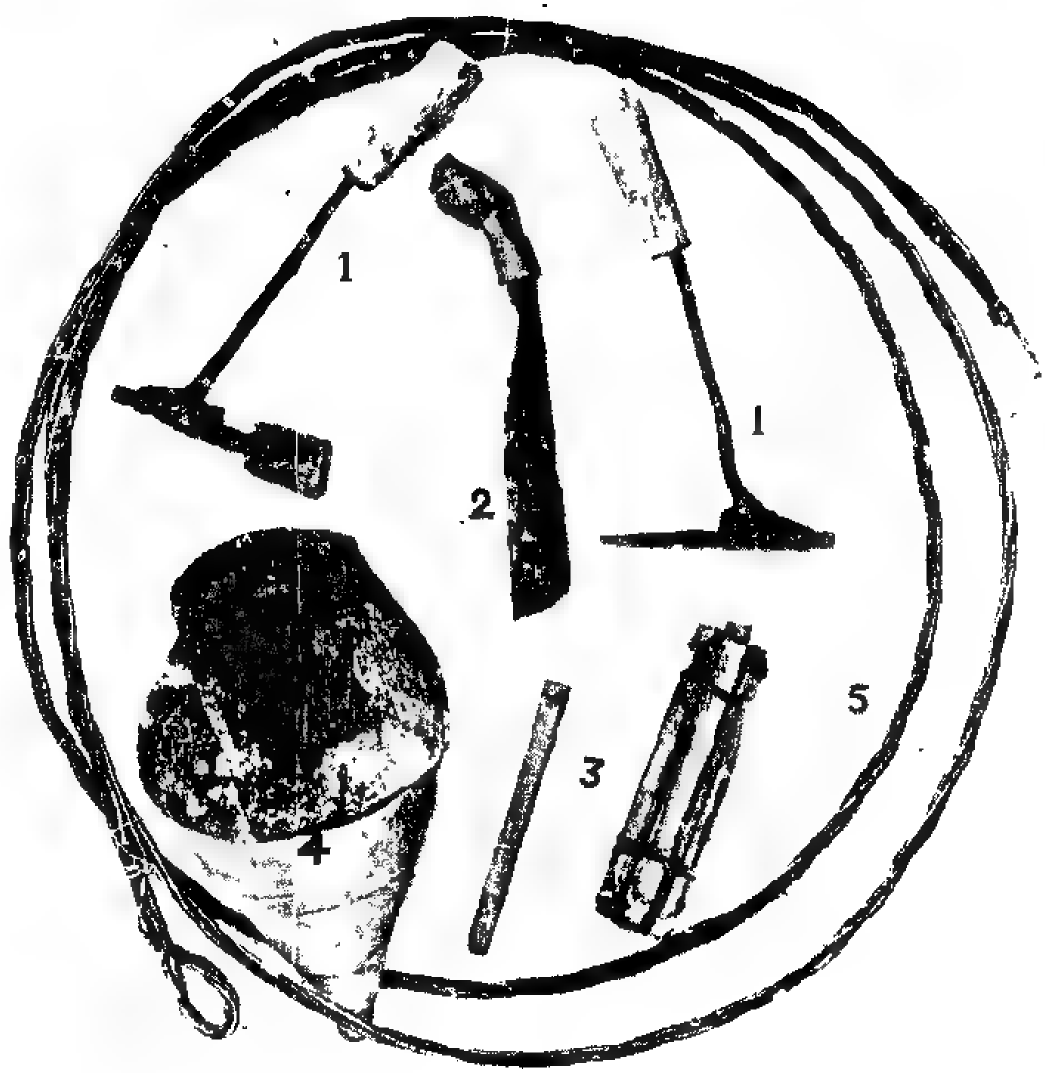
Such tappings must be examined and passed by an inspecting officer before payment is made. After two months or more they are reopened and again paid for. The trees should then begin to produce sufficient damar to cover the cost of collection, and no further subsidy should be necessary, but no definite ruling can be laid down.

22 The first bole taps are more or less semi-circular in outline, the base being formed by a horizontal cut about four inches long, penetrating about half an inch into the wood. Exudation takes place from the extreme outer portion of the sapwood, and appears to be largely the result of irritation set up by the wound. There appears to be no advantage in making cuts deeper than one *inch, neither is this desirable on account of the value of the timber* In some places, notably northern Johore, where uncontrolled basal tapping has been going on for many years, the cuts have been enlarged and deepened to such an extent that trees have been not only girdled and killed, but actually structurally weakened by the continuous and quite unnecessary deepening of the cuts

23. Branch taps are made on either side of the main branches and are more or less elliptical in outline. They do not require the horizontal base, the object of which is to prevent the damar from running down the trunk as the damar hardens sufficiently quickly to form "stalactites" which, from the position of the cuts, remain suspended in mid air and do not come into contact with the bark. These exudations are, therefore, generally much cleaner than those from bole taps, and the cuts are usually more prolific.

24 The damar exudes in the form of a transparent, almost colourless, intensely sticky liquid. It takes some time to harden, and no attempt should be made to remove it until three months have elapsed, otherwise the later exudations will be found to be tacky and not only valueless in themselves but capable of detracting very considerably from the value of any hard damar with which they may come in contact. Paleness, hardness, and transparency being the three cardinal virtues of good damar, the greatest care must be taken to keep the wounds as clean as pos-

Uncontrolled basal tapping. The yield from trees treated in this way is small, and the damage to the timber is quite unnecessary (Para 22).



TAPPING IMPLEMENTS.

1. *Beliong*, showing the head set in two positions. (Compare Plate 22).
2. *Parang*, the common Malay chopping knife.
3. *Peting*, or bamboo pegs used for climbing. (Compare Plate 21).
4. *Kuchau*, for holding damar. Often (as in Plate 22) a basket is used.
5. *Sengkolok*, or climbing rattan. (Compare Plate 22).

sible and to judge the time of collection so that the damar has time to harden right through but does not stay on the tree long enough to darken or to become dim on the surface.

25. Some trees produce what is known as "dead" damar, similar in every respect to the normal, but opaque, of the colour of condensed milk. The reason for this is obscure, though there seems good reason to believe that the opacity is due to an excess of water brought about by some physiological function

The same tree may produce clean and opaque damar from different taps, or both kinds may flow, side by side, from the same tap. This phenomenon has only recently attracted more than passing attention. Attempts are being made to encourage the collection of this opaque damar as, although it is at present unmarketable, its unpopularity appears to rest on prejudice rather than actual inferiority whilst there is some prospect that continued tapping may lead to the production of clear resin. This subject is discussed further in the section dealing with sorting and grading.

26. The most suitable instrument for basal and bole tapping is a small Malay axe, or *beliong*, an implement resembling the Burmese *kyettaung*. Normally used for felling trees, this axe has a chisel-like head prolonged at the back into a spike, by means of which it is lashed to a grooved receptacle embodied in the handle. The head can be turned to any angle and used either as an axe or an adze, as shown in the illustration (Plate 19). The *parang* or chopping knife is used for branch tapping. The objections to its use for bole tapping are that it is not easy to make with it a horizontal cut when working on a perpendicular surface at a height above the ground, and that there is always the possibility of accidental severance of the climbing rattan described later. It is essential that the edges of the tapping implements be kept very sharp and that they be flat or hollow ground rather than convex as the latter form is apt to bruise and close the resin ducts and prevent a free flow.

27. Some of the climbing devices adopted by the tappers are extremely ingenious. Many of the trees have clear boles for 80 or 100 feet, above which height the work of the branch tapper begins. If there is a convenient liane it may be possible for him

to swarm up it, up of a rope, either direct or from the branches of a neighbouring tree. Where there is no such natural rope, an adjacent tree is climbed and a passage sought in the branches. If this does not exist, a bridge is made by lashing a pole from one to the other (see Plate 20), an operation requiring considerable nerve and necessitating the use of a hooked stick (*changkoh tandung*) to pull the branches together. Should no natural climbing facilities exist, a ladder is constructed by driving bamboo pegs (*peting*) into the stem at vertical intervals of three or four feet and lashing poles to them one above the other in the manner shown in the illustration (Plate 21) The pegs are driven in with a mallet and must not reach the heart-wood, otherwise they will be dislodged by further blows.

28. The methods described above are resorted to by branch tappers only. Bole tappers generally use the *sengkolok*, a strong piece of flexible rattan passed round the stem and under the armpits of the climber, secured with a simple knot conveniently placed at his side Using the taps as steps he is able, barefoot and without the use of irons, to ascend and move around the bole with surprising ease, tightening the *sengkolok* to suit the taper of the tree. (see on next page, Plate 22). Having both hands free he can manipulate his tapping implement without hindrance and, should his feet slip, the worst that can happen to him is a severe scraping until the rattan has tightened and checked his fall. As already stated, the use of a chopping knife is undesirable with this arrangement, as the climber's life depends on a thin strand of rattan. There is very little danger of accidental severance with the narrowfaced tapping axe.

29. Climbing irons have been tried without marked success and, as they damage the tree, their use has been discouraged. Inexpert climbers use rough ladders made on the spot, but it is not practicable to go higher than about 20 feet with them, and they rot very quickly in the jungle. Portable ladders of sufficient length are weighty, unwieldy, and altogether unsuitable. Iron staples driven into the stem to form a permanent ladder are in use in Perak. They are satisfactory enough from the point of view of the climber, but they are somewhat expensive, and their

Method of crossing from one tree to another by means of the *changkoh tandang* and lashed poles. (Para. 27).

Note. Neither of the trees is *penak*.

Climbing by means of *peting* (Para. 27).

Note.—The buttresses of the tree are abnormally large.

The climbing rattan (*sengkolok*) in use (Para. 28). Note that the taps are used as steps.
The tapper is chipping off the damar with a *beliong* (Para. 26).

use is undesirable in another important respect. Trees that have ceased to yield a profitable amount of damar should be available for timber, and the mere possibility of finding iron spikes in the wood is sufficient to frighten off any saw-miller. Reducing the number of staples by increasing the vertical interval and using a scaling ladder to bridge the gaps has not proved at all popular, because of the feeling of insecurity. Replacement of the bamboo pegs, already described, by eyed iron spikes, is open to the same objections as the use of iron staples. The climbing rattan is undoubtedly the best device as it can do no harm to the trees and is quite reasonably safe. It is worthy of note that there have been no serious accidents to tappers during the period of departmental control.

30. The initial taps have already been described. Subsequent operations consist of the removal of the exuded damar by chipping it off into a conical bark receptacle slung around the tapper's shoulders and known as a *kuchau*, followed by the refreshment of the cut by the removal of a thin slice of bark and sapwood on its periphery. The head of the tapping axe is turned to whatever angle best suits the position of the tapper.

31. Taps are spaced in rows beginning at the foot of the tree, with a vertical interval of about two feet and a horizontal interval of 1½ feet. Up to the height that a man can reach the taps are called "basal"; above this to the branches they are known as "bole"; whilst "branch" taps are confined to the actual branches, the tapper sitting astride or even lying on his face to work them. Though there is no reason to believe that simultaneous tapping by all three methods would harm the tree, in actual practice it is unusual for branch tappers to work the stems, and bole tappers are reluctant to run the risk of working amongst the branches, though both in quality and quantity the latter method is superior. Consequently, few trees are tapped to their full capacity. Exploitation of the same tree by two tappers would solve the difficulty, but this would involve mutual trust and a definite understanding that could scarcely be hoped for with casual spare-time labour.

32. In such circumstances the yield of damar is difficult to determine It is said that a good tree tapped quarterly, will produce a *pikul* (133⅓ lbs.) or more per year, and that a tapper can deal with two trees per day, so that the output of the thirty odd trees allotted to each man should be in the neighbourhood of 30 *pikuls*, or say 40 cwt. per year. Actual experience has shown that an average of about 6 *pikuls* (8 cwt.) is as much as can be expected from a part-time collector who is, therefore, gathering only about one-fifth of what his trees should be capable of yielding Placing the possibility per tree at only half a *pikul* (67 lbs.) and allowing a rotation of four months instead of three, it seems reasonable to expect an active man to tap at least 30 trees per month of only 20 working days' day. This is equivalent to 360 tappings per year, or 120 trees each tapped three times and producing (at half a *pikul* each) a total of 60 *pikuls*. To sum up, the present casual tapper with his average of 6 *pikuls* from 30 trees is only averaging about four full days' work per month, and is monopolising nearly double the number of trees that his efforts entitle him to. And even this meagre output can be maintained only by constant pressure and persuasion on the part of the supervising staff.

(f) Purchase.

33. Damar is taken by the collectors to receiving stations established at convenient centres for its purchase for cash at fixed rates. Only two grades are recognised at this stage, *viz.* "First Quality" and "Dust," the former being the residue after the latter has been eliminated by passing through a sieve with an eighth inch mesh, the rates of payment being 12 cents and 4 cents per *kati* (about 2½*d.* and 1*d* per lb.) respectively. This may seem a low rate, but experience has shown that higher payments result in an even smaller output. Moreover, as has been shown above, it is possible, by working only 20 days, to collect 5 *pikuls* (nearly 6 cwt.) which, at 10 cents per *kati*, would be worth \$50 (£5 16), and this figure does not take into account the bonus payments described in the next paragraph.

34. With the object of increasing the output, a bonus scale has recently been adopted. Settlement is made every quarter

the minimum qualifying outturn being 150 *katis* (200 lbs.), which entitles the tapper to a bonus of 1 cent per *kati*. For every 25 *katis* in excess of this minimum the bonus increases by ½ cent. To prevent a pooling of damar and to encourage greater co-operation amongst the collectors this bonus, although payable on the actual outturn of the individual, is not paid to anybody unless the average for the whole division exceeds the prescribed minimum. It is hoped, by this means, to bring the weight of local opinion to bear on the slackers and to encourage a higher standard of efficiency.

35. The forest guard in charge of the receiving station or (where the output does not justify a special building) of house to house collection is responsible for the quality of the damar that he takes over. He refuses to accept stuff that is unreasonably dirty, and he confiscates any that has not properly hardened. It has also been the custom, up to now, to confiscate the opaque "dead" damar described in paragraph 25, but unless it is the produce of a tree that has been definitely put out of action on that account it is not advisable to penalise the tapper for defects that are beyond his control.

36. The proportion between "First Quality" and "Dust" averages about four to one. The collectors naturally do their best to avoid pulverising the damar, not only because of the superior price paid for the lumps, but because fine dust is not accepted at the receiving stations on account of the possibility of adulteration with inferior damars that could not be detected if ground up small.

37. When sufficient stock has been accumulated the damar is brought in to the central store, where the weights are checked with the totals shown in the purchase account kept at the receiving station. The guard then takes his purchase book and vouchers to the District Forest Office where his accounts are checked and his cash advances recouped.

(g) Sorting and Grading.

38. The actual sorting is done by women and children, mostly Chinese looked after by Malay *mandors* or forewomen.

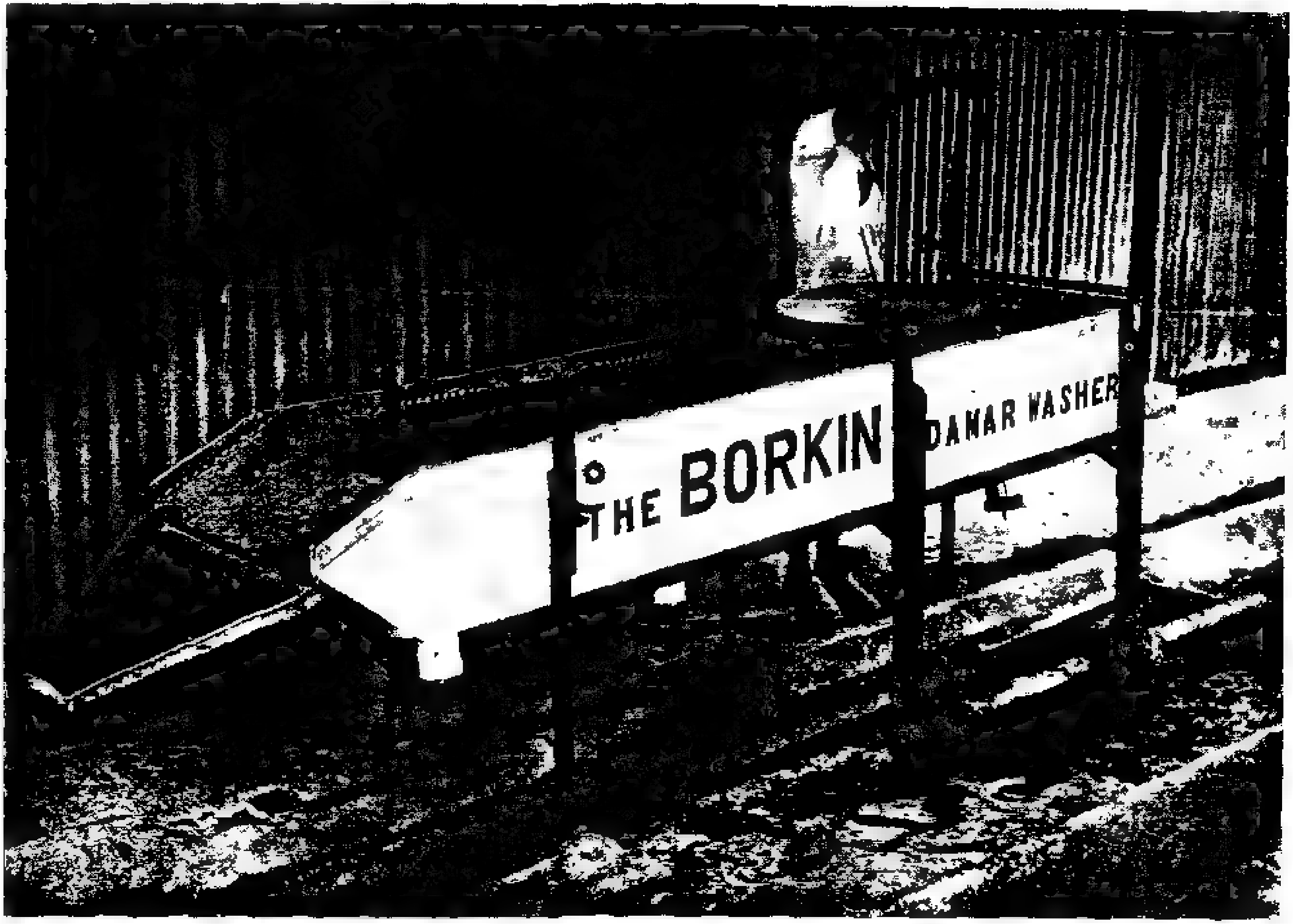
The store is in charge of a Malay Ranger, the only other males being a couple of casual hands who do such heavy work as shifting cases and pumping water for the washer. The first operation in the sorting of "First Quality" damar is to pass it through a sieve *with a mesh of about* ⅛" *in order to remove the* dust and the particles that are too small to be sorted by hand at ordinary rates

What remains is then measured out into empty four-gallon kerosene tins, which will hold an average of 22 *katis* (27½ lbs.). For completely sorting and grading the contents of one of these the rate is 65 cents (about 1*s.* 6½*d.*). To ensure thorough grading of the smaller fragments the contents of the tin are passed through a ¼" sieve, and anything that gets through must be sorted to the satisfaction of the forewomen before work may be started on the larger pieces. This precaution is important, as bad sorting of the finer pieces would pass unnoticed if they were mixed up with the rest. There is no dearth of labour in the sorting shed, mothers bringing their children to help them at a task that is neither strenuous nor harmful, and at which they are not tied down to definite hours.

39 The grades that have been adopted as standard are:—Pale, Yellow, Amber, Coarse Dust, and Fine Dust. The size of the fragments plays no part in the first three, except that dust is excluded, for though it is true that buyers prefer the larger pieces the distinction is entirely arbitrary and quite unnecessary provided the quality can be guaranteed. The colour grades are, however, of the greatest importance and, to guard against any lowering of the prescribed standards, doubtful pieces are invariably relegated to the inferior (darker) quality. Pale damar is almost colourless with a faint yellowish tinge, Yellow is of a primrose shade; whilst Amber has a definitely reddish tint.

All, of course, are transparent. Generally speaking, the darker the colour the longer the damar has been allowed to remain on the tree.

40. Dust, as purchased at the receiving stations, and as removed by the *preliminary sifting of "First Quality" damar*, contains particles that are large enough to be sorted by hand



The washer for removing impurities from damar that is too small to be sorted by hand picking (Para. 40).

but are too small to be fairly included in the tins for sorting at the regular rate. These are extracted by sifting and freed from the worst impurities by means of a specially constructed washing machine (Plate 23) in which water, flowing over a series of tanks carries away the lighter pieces of bark and allows the heavier damar to sink to the bottom. After treatment in this way the damar is dried in the sun and then picked over by hand, the best of it being included in the " Yellow " grade, whilst the rest joins the dirty or confiscated " Coarse " grade that is considered to be below the export standard and is, therefore, marketed in Singapore.

41. Purification of dust is not possible by either hand or water, the particles being too fine and their specific gravity too low. Laboratory experiments are proceeding with the object of solving this difficulty, which is not peculiar to the *penak* industry. In the meantime, the only possible grading is one of size, that known as " Fine " being of the consistency of flour (incidentally extremely inflammable or even explosive in a state of suspension) whilst " Coarse " dust is composed of particles resembling rather fine Demarara sugar. The non-acceptance of fine dust at the receiving stations ensures that any such dust at the central store is a product of disintegration and is free from adulteration.

(h) Packing and Marketing.

42. The colour-graded damar is packed in paper lined wooden boxes holding about 140 lbs, whilst the dust is despatched in triple rice sacks holding about 175 lbs. Close packing is essential to lessen further disintegration when the boxes are handled, some of the early shipments having suffered rather severely on this account. A certificate of origin, bearing the registered trade mark of a tiger's head and signed by the District Forest Officer (who personally superintends the packing) is enclosed in each case. To guard against fraudulent use these certificates are only recognised as valid within three months of the date of issue.

43. The whole outturn is sent by train to Singapore, where it is received and forwarded by agents working on a commission basis. This is not the place to discuss the intricacies of shipping, broking and sales. Suffice it to say that the damar is now becom-

ing familiar in the home and continental markets where *Malayan Damar Penak* (or M. D. P.) is recognised as a first-rate product of guaranteed purity, sufficiently highly standardised to be bought without sampling or on forward contracts. No difficulty has been experienced in disposing of the whole output at prices from 45*s.* per cwt. for the fine dust to 145*s.* per cwt. for the best pale grade. The best prices for dust are paid by continental buyers. The American market has as yet scarcely been touched as the present output is only a little over 100 tons per year.

(i) *Conclusion.*

44. The possibilities of the industry are obviously great, if only the labour difficulty can be overcome. There are few examples of two really high grade products being obtained from the same tree, but both the damar and the timber of *penak* are at the top of their respective classes. As reasonable tapping appears to have no growth-retarding or deleterious effect on the tree the production of timber is not affected, so that the two industries can proceed simultaneously, each unhampered by the interests of the other. The number of trees in actual (though by no means regular) tapping is estimated at 7,500 in the Negri Sembilan, and 2,000 in Upper Perak. This total of 9,500 is very approximate, but a very conservative estimate places it at less than 10 per-cent. of the trees that might be made available. A more than usually prosperous future appears to be assured though not, it is to be feared, without the help of imported labour.

(*Concluded.*)

THE PROBLEM OF SAL REGENERATION WITH SPECIAL REFERENCE TO THE "MOIST" FORESTS OF THE UNITED PROVINCES.

(Continued from pages 500—511, September issue.)

36. We have discussed the effects of burning on the undergrowth and underwood. What of its other effects on the sal-

seedling it is designed to preserve and perpetuate, on the mother trees, and lastly on the forest soil ?

37. It must at once be stated that fire is only employed as a *pis aller*. If we could remove the leaf layer and eliminate, or at least reduce, the undergrowth in any other way, burning would not be resorted to. Fire is a weapon the potency of which lies in its selective action and it is simply because sal, from earliest youth, is so exceptionally resistant to its effects that we are emboldened to employ it so freely.

38 Instances of this hardiness abound and we need not turn to Nepal for examples. In Lakhmanmandi (Haldwani division) a 50' scorching fire failed to kill two-year old sal. Far more remarkable is the case, recently cited in the *Indian Forester*, of the Hathiwala fire-line in Dehra Dun division. Here an abandoned strip is raising, on dry sand-rock and clay, an almost pure crop of sal poles after 30—40 years annual firing. Incidentally, from this and other results it may be anticipated that the moist sal forest of the future will be exceptionally pure from birth.

39. Regular burning, however, is too new a development for any sound appraisement of its effects to be possible. The chief drawback urged is that the sal regeneration is checked just at the time of aerial growth and the succeeding shoot weakened by having so much the less root-storage to draw on for its initial ' burst.' As burning is generally carried out some time in April, the check, which may operate on all—but particularly the younger—stages of regeneration, cannot be avoided entirely. Fires in May, indeed, have been known in this manner to kill the younger seedlings outright. Earlier, however, they are in no wise fatal and the resultant shoot, weak as it may be, stands to benefit, out of all proportion to the original handicap, from its altered and ever-altering environment. Even from the initial burning, the sal shoot (which is one of the first things to reappear) enjoys a new, if temporary, access of light and air.

40. As for the mother trees, proper precautions in the first few critical years can prevent injury either to stem or flower. As

soon as the weeds have become materially reduced, burning becomes a light affair, innocuous, as experience shows, even to young recruitment

41. As regards the actual time to weed burn, practice has varied somewhat but in the United Provinces the opinion seems to be gaining ground that later burnings are preferable. An early (April) fire has the great objection that it leaves smouldering stumps and *debris*, which are a source of danger throughout leaf fall. Moreover burning in the latter part of April is always clear and complete, rarely does harm to the overwood, and appears to be less severe on the sal regeneration than was at first anticipated. Hence there is a growing tendency wholly to combine the operations of weed and leaf burning, even although the latter may not of itself be necessary. It is thus that the leaf-layer, in its rôle of kindling agent, enables us greatly to intensify our campaign.

42 The effect of burning on the soil has been greatly debated and appears to require much more investigation. Entirely harmful it cannot be. Apart from the production of potash, burning is probably beneficial, as a flocculating and sterilising agent, on damper, heavier ground, the texture and bacteriological content of which may undergo important modifications, provided the heat is not too transitory*. For the rest, such harm as accrues is likely to be temporary, and we may look upon it as part of the price that has to be paid for our natural sal crop

43. To sum up, there is every reason to believe that a régime of burning, carefully and systematically conducted, will eventually solve the regeneration problem of the moister sal forests.

After all it is no artificial remedy; rather a return—and a regulated return—to natural conditions. We are restoring a factor of environment which may be as necessary to the perpetuation of sal, in these tracts, as the fierce fires that condition the regeneration of certain pines in the Western Hemisphere.

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* *See for example the work of Pfeiffer and Franke and of Krüger and Schneidewind.*

With the regeneration increasing in vigour as the undergrowth declines, it should be possible to suspend burning operations, simultaneously opening the canopy, and so give the emancipated regeneration a powerful and decisive stimulus.

Burning, in a nut-shell, must be the short cut to a more open canopy.

44. We can now come to details and formulate a comprehensive scheme of regeneration in which fire takes its rightful place.

As a preliminary, certain definitions are necessary. The peculiar nature of our subject has tended to confer a specialised meaning on certain ordinary words, no less than to create new expressions, which are its special nomenclature In the present text these have invariably been employed in the following sense :—

Seedling year.—A year in which there occurs the combination of seed and timely rain (may be "full" or "partial," widespread or local).

Regeneration
- *Recruitment*—Seedlings up to one foot high (Also, in the abstract sense, the stocking of an area with seedlings.)
- *Reproduction*
  - (*a*) Unestablished—*Whippy* shoots from one foot in height upwards.
  - (*b*) Established--Obviously *woody* shoots, at least of thumb thickness and ready to shoot up into saplings.

Advance growth.—Regeneration that exists before conversion fellings are started.

NOTE.—Although established reproduction is woody, it is by no means certain that all woody reproduction is established.

Establishment period.—The time it takes seedlings to produce a persistent shoot of breast height.

NOTE.—"Establishment" and "established" should properly imply that condition referred to in para. 21 when the reproduction is assured of survival. However, "*usus est tyrannus*;" in any case such a condition is not one likely to be recognisable in the field or to have any but theoretical significance. Accordingly, the current sense of "maturity" has been accepted.

The following terms are self-explanatory :—

Leaf / Weed / Slash	burning	Die-back. / Die-out.

Finally, the word "canopy" is meant to include that of both overwood and underwood.

45. The scheme of regeneration suggested is as follows :—

SCHEME OF SAL REGENERATION.

(*i*) All compartments in the Circle, or at least all those in P.Bs. I and II, with any considerable weed growth will be burnt as a matter of routine every year.

NOTE.—(*a*) The prescription has to be read with (B) (*c*) page 566.

(*b*) Young pole and sapling crops are, of course, exempted, but in the nature of things they seldom contain many weeds.

(*c*) The third week of April is generally a satisfactory time for burning, but this is a matter entirely for the D. F. O. to decide each year and for each compartment : incomplete burning is to be avoided at all costs.

(*d*) The presence of felling *debris*, or of a degree of grass, or of exceptionally dense weed-growth may render earlier burning necessary. Dense weeds may even have to be cut back previously. A second burning will ordinarily be required later—leaf burning considered apart. (See (*ii*) following).

(*e*) In the year or two following a seedling year burning may be withheld wherever recruitment has occurred.

(*f*) In areas where weed-growth is particularly rampant, cutting back may also be done at the end of the rains.

(*ii*) Whenever there is reasonable expectation of a seedling year, areas selected for regeneration will be leaf—burnt; this prescription overlaps (*i*) above.

NOTE.—(*a*) Compartments containing grass may be exempted at discretion.

(*b*) Compartments incompletely stocked with regeneration are only *potentially* more advance than those that have none.

For each type of area the regeneration process will be as follows :—

A) In forests of the Dry Type	(C In forests of an intermediate character	(B) In forests of the moist type.
I.—With little or no grass. (*a*) A light * preparatory felling may be made. (*b*) The leaf cover will be burnt towards the end of April	*I.* With *intermingled* grass and weed growth.—(A) *I* or (B) *I* will apply according to the dominance of one or other component.	*I. With little or no weed-growth.* (*a*) A moderate * preparatory felling may be made. (*b*) The leaf cover wil. be burnt towards the end of April (*c*) After a full flush of recruitment has appeared, if the weed growth continues sparse a further opening of the canopy may be made
II.—With much grass (*a*) Grass will be burnt as soon as it can be got to burn satisfactorily. (*b*) The leaf cover will then be burrt towards he end of April.	*II* With *gregarious* grass and weed-growth :—So far as possible each treatment will apply in its own locality If necessary, grass-cutting can be substituted for (A *II* (*a*). Where A(*c*) and B(*d*) are incompatible, the relative proportion of "dry" and "moist" forest, and particularly of A) *II* as opposed to B) *II*, will determine which prescription is to stand	*II —With much weed growth.* (*a*) The leaf cover wil be burnt towards the end of April. (*b*) Wherever a full flush of recruitment has appeared—
III —In both. (*c*) Wherever a full flush of recruitment has appeared, burning will only rarely and tentatively be carried out † (*d*) Interference with the canopy will at all times depend essentrally on the state of the grass growth If it is at all dense, no lightening of		*III —In both.* (*c*) Weed burning will proceed for as long as there is *enough undergrowth to compete seriously with* sal regeneration, or until grass commences to replace it substantially (*d*) The canopy may then be further opened (*e*) Burning will be resumed if and when weeds recommence to compete with sal regeneration, in which case (*d*) and (*e*) will again operate. (*f*) If grass has been established instead, A(*c*) and (*d*) will apply.

the canopy will be allowed. If it be sparse, or non-existent, the canopy will be opened to such extent as will allow a moderate development of grass.

These measures may be expected to induce a parallel growth of grass and sal reproduction.

(g) When the reproduction is clearly established throughout a selected area the following conversion operations will be carried out:

(i) Felling of the remaining overwood and all underwood except *jaman (Eugenia Jambolana)* followed by—

(ii) Cutting back of the larger advance growth close to the ground.

(iii) Burning of the whole area as soon as ever a clean fire will result.

If frost is to be feared, these operations may be modified as follows:—

(i) As much of the underwood will be preserved as is thought necessary.

(ii) Where the underwood is inadequate, standards will in addition be retained from the overwood, always preferring—
Kokat to sal or *sain (Terminalia tomentosa)*.
A low diffuse crown to a high compact one.
A poor tree (within limits) to a good one.

(iii) This "skeleton" shelterwood, *i.e.*, the standards and all underwood except *jaman (Eugenia Jambolana)* (which may be kept permanently) and *rohini (Mallotus philippinensis)* (which it is better to pollard or else leave alone) will be girdled as soon as the sal is out of danger.

* Assuming the initial density is not abnormal.
† Until we know more of its effect on sal regeneration in grass. Occasional early burning may well be beneficial.

46 The following points should be noted :—

(*a*) Preparatory fellings may be omitted if the forest floor is already hardened by grazing.

(*b*) Throughout operations the underwood, in so far as it is able, and required, to function for the main canopy, will always be preserved but if *rohini* is the chief constituent, its timely suppression (by cutting back before burning) may have to be considered.

(*c*) When the reproduction is maturing, test cuttings-back over small areas of minimum shade will indicate readiness or otherwise for conversion.

(*d*) Cutting back of the larger established reproduction should be completed before sap rise.

(*e*) Clear conversion must be encouraged in every possible way: concentrations of slash must, at all costs, be avoided.

(*f*) Slash burning may be omitted at discretion if—

(*i*) It is likely to be very fierce.*

(*ii*) The area is, or will likely be, deer infested—when the protection afforded by slash to sal shoots may outweigh any obstructive effects.

In such cases, all established reproduction will have to be cut back.

(*g*) If conversion operations can be carried out in one working season so much the better, especially in dry areas where the grass will receive 12 months' start over the sal and there is danger of an unavoidably fierce fire killing (in part or whole) the protective underwood.

* The opinion is advanced that much unsoundness may be caused *ab initio* by regeneration being burnt below the collar during an intense fire.

47. So much for a regeneration policy framed to meet every condition. It only remains to notice that there are always some areas where nothing will induce regeneration on any scale. In these, supposing forestry to be practicable at all, artificial works—soil breaking, weeding and the like—may have to be undertaken or else a new species introduced. The cause of such "soil sickness" (to use a vague but common expression) is at present obscure but there are a number of possibilities :—

(*a*) A high incidence of game (deer, pig, etc).

(*b*) Local changes in the water level (which may be reflected in the condition of the overwood).

(*c*) Periodic flooding of the area.

(*d*) Insect or fungus epidemic (attacking seed or seedlings)

(*e*) Some factor as yet unknown, such as absence from the soil of an essential mycorhizal fungus.

(*f*) Combinations of the above.

48. From silviculture we must now proceed to management. Having propounded our scheme we must show how to apply it , at no time, least of all at the present juncture, can this be a haphazard business.

49. The whole problem, we have seen, centres round the "period of establishment." How long, actually, this period is, and how much its duration will vary for different localities, only time can show. We can at least be certain that the solitary decade hitherto perfunctorily accorded will never even approximate to reality. Always a guess, its tacit assumption has long prevented the adoption of an adequate regeneration policy. It is, however, obviously essential to the frame-work of management to fix on some figure—and that a liberal one. We are fortunately not reduced to mere guess work In dry areas, where existing treatment can differ but little from that prescribed, there are indications that establishment will take about 30 years. On well-drained (moist) fertile loams we may hope to make it much

less—say a couple of decades—but in the absence of any data the larger figure may provisionally be accepted for dry and moist alike.

This fundamental hypothesis orders the whole framework of management. What are its implications?

50. Suppose we take a newly formed *conversion* circle having (like several important ones in the U. P.) three periods of 40 years each; let us, further, assume a P. B. I innocent of regeneration, but *flushed with seedlings in 1927. In 30 years time* theory permits the silviculturist to throw out (as converted) ¾ of P. B. I and to work the remaining ¼ during the following decade. Meanwhile ¾ of P. B. II has been brought in *en bloc.* Some of this must be ready for conversion in ten years and the rest in 20—30, since at every revision of the plan one quarter (10/40) of P. B. I should be thrown out. Obviously, then, these P. B. II areas must carry a gradation of regeneration, the theoretical (minimum) stock in 1957 consisting of:—

1/3 area 20 years old.
" " 10 " "
" " (1 year) seedlings.

While the whole block may be shown thus:—

	30 years.	¼ Old P. B. I.
¼	20 "	¾ New P. B. I.
	10 "	
¼	(1 year) seedlings.	

51. This last represents the ideal condition of P. B. I—the P. B. I of the normal forest. By employing horizontality for time and verticality for area (though both only in a qualitative manner) the whole process of regeneration can be formally represented as follows:—

Decade	Decade	Decade	Decade	
Converted and thrown out into P B. III.	*Under conversion.* 40—30 years regeneration	ESTABLI 30—20 years regeneration	SHMENT 20—10 years regeneration	¼ of block
Under conversion. 40—30 years regeneration.	ESTABLI 30—20 years regeneration	SHMENT 20—10 years regeneration.	PERIOD 10—0 years ← regeneration.	¼ ,,
ESTABLI 30—20 years regeneration	SHMENT 20—10 years regeneration.	PERIOD 10—0 years ← regeneration.	Any necessary preparatory fellings and burning	¼ ,,
ESTABLISHM- 20—10 years regeneration.	ENT PERIOD 10—0 years ← regeneration	Any necessary preparatory fellings and *burning*	Ordinary P. B. II thinnings.	¼ ,,

52. We can now come to a measure of actuality.

A full seedling year arrives, say, in 1927. The whole of P. B. I is leaf burnt and regenerated (*i.e.*, stocked with seedlings). Theoretically, we saw, after ten years ¼ (10/40) of P. B. II would also be so treated. Actually, since seedling years are intermittent and irregular, at least $x/40$ (where $x =$ the number of years elapsing since the last seedling year) must be leaf burnt every time sufficient seed forms, and the principle holds good, of course, whether the conversion rotation starts with a seedling year or not. Thus should a seedling year first materialise in, say 1935, 1/5 (8/40) of P. B. II would be leaf burnt for it; with another in 1940, a further 1/8 (5/40) and so on, the area thus being systematically stocked with batches of recruitment.

53. A metaphor which the last term suggests will further elucidate the process. In 1927 the whole army of seedlings in P. B. I marches off on its 30 years journey. At every succeeding seedling year P. B. II must furnish its quota of recruits. How big are these drafts to be, and how far behind the main body and each other? In a nutshell, *the size of any one draft will be proportionate to the interval, between it and the one preceding.* The bigger the interval, the bigger the draft.

54. Now the above technique is of general application. Once accept 30 years as the period of establishment—there are

those who would make it much longer—and the necessity for immediate regeneration throughout the first periodic block becomes obvious in the extreme. Even so, the hypothesis is all too apt to find favour without its corollary. The accumulation in P. B. II of further stocks of regeneration is an equally vital step, and while tantamount to regenerating in two blocks simultaneously the peculiar characteristics of sal should allow of the process without any material entrenchment on our second period yield. The whole, in fine, constitutes an abnormal anticipatory programme designed to ensure that, after 40 years are up, P. B. II will be in a condition to allow of steady conversion. By that time we should have achieved a practical approximation to the normality represented in our table.

55. In actual working, of course, we shall be well advised greatly to exceed the minimum programme indicated. Besides the area under systematic weed burning, there is no reason why all compartments of P. B. II free from heavy grass growth should not be leaf burnt every time seed forms in any quantity.

56. We have now to relate the whole procedure to current working plan practice. Here some important facts emerge. In the first place few divisions in the U. P. have allowed themselves more than 30 years for the conversion of P. B. I, even when very deficient in advance growth. Secondly, conversion fellings have been in progress for anything up to a dozen years and it is admitted that recruitment has generally lagged far behind (if it has ever even followed) exploitation and that most of the possibility has been derived from fellings over advance growth.

57. These facts form a joint problem of pressing importance. Let us study it in two particular cases.

58. Conversion started in Dehra Dun division in 1923 with three periods of 32 years each. The presence of pole crops and advance-growth in the regeneration area (P.B. I and VI) was held to justify its conversion in 20 years. Now clearly this is an impossible contract. The existence of reproduction in one part of the block cannot speed up establishment in another. The unregenerated portions require their 30 years just the same—

actually more if (as was here the case) a seedling year delayed. In fact the period of 32 years was *itself* too short unless :—

(*i*) A full seedling year arrived by 1925.

(*ii*) The regeneration process was started simultaneously in P.B. II,

—neither of which conditions was fulfilled.

59. Let us next turn to Haldwani division. Its case is of special appositeness because here conversion (1914) followed auspiciously on the heels of a bumper seedling year—comparatively little advance growth existed. Twenty years were allotted for the conversion of P.B.I, which was 1/6 of the whole Circle. Six years fellings saw the general disappearance of the 1914 regeneration and the introduction of a revised plan which, if it wrote down the yield, also shortened the period (three blocks of 30 years).

60. The deficiencies here are patent, but they differ in some respects from those of Dehra Dun. Thus the yield, and with it the period, began by being theoretically correct (since 1/6 ÷ 20 = 1/3 : 40) but a third, not a sixth, of the circle should have been regenerated initially, and recruitment operations also started in P.B. II (the P.B. III of the first plan). The revised (30 year) contract was open to objections already detailed for Dehra Dun division.

61. Cases such as the above are clearly examples of over-felling and everything points to a reduced yield in the near future. The principles on which reorganisation must be based are well defined. The precise length of the regeneration period will vary but in many instances it is unlikely to sink much below 40 years, at least as a temporary denominator in the yield formula for P.B.I.

62. There is a weightier reason for this than mere uncertainty about the next seedling year, or the exact period necessary for establishment—a reason, moreover, which, by setting a true value on the presence of advance growth, reinforces the arguments that would discount it in our new calculations.

63. A feature of the technique laid down is that it permits fellings to be neither drastic nor early, at least for as long as

weed growth is so rampant everywhere, and while the rules, as all rules should, leave the silviculturist some latitude, it remains to be seen how far expediency may be served without grave prejudice to the new crop.

64. If, therefore, in a block poor in reproduction, some particularly lean years are ahead the dry type of forest—inherently rich in advance-growth though it may be—is often likely to feel the pinch with scarcely diminished force, even if in more transitory fashion. In the one there is no inheritance for us to rely on; in the other, that patrimony has already been largely exhausted. It is thus that Dehra Dun and Haldwani divisions have come by somewhat different roads to the same pass. The former realised an excessive yield on the strength of reproduction and poles already existing; the latter barely drew the theoretically correct yield but over-felled because recruitment did not keep pace with exploitation.

65. Enough has been said to show the need in such cases for a very cautious estimate of the yield, particularly in the first decade or so. At the same time, certain mitigating factors may operate during the period of stringency and partly relieve it. The chief of these are:—

(*i*) The inclusion in P.B. I (by the enlargement of the circle) of new areas that are densely stocked, or contain advance-growth or poles and saplings below a substantial overwood.

(*ii*) The presence of many coppiceable stools.

(*iii*) Local artificial regeneration.

(*iv*) Systematic cutting back of the undergrowth.

(This, of course, is one stage better than burning, since it saves the sal regeneration ; on the other hand it does not remove the leaf layer. Anyhow, the expense of the operation prevents its superseding fire on any scale.)

(*v*) The removal of sal where an underwood can suitably function in its stead. (See para. 46 (*b*).)

Over and above all this, selection fellings in the intermediate blocks carried out under certain definite safeguards would constitute a perfectly defensible expedient in order to make up the theoretical yield.*

66. *As we get surer of our technique, and uncertainty is* banished by the arrival of a full seedling year, the situation will clarify and successive revisions of the yield will reflect the increasing scope for heavier and more concentrated fellings.

67. It might be thought that even under normal conditions an equal annual yield could never be obtained. Now the marked periodicity of sal seedling years undoubtedly robs the regeneration process of those features which species more consistently reproductive have taught us to consider characteristic. Essentially, the element of *gradation* appears lacking, for regeneration must necessarily be present in large "age classes"—the larger the less frequently seedling years occur. It would seem therefore, that fellings must become stereotyped, the possibility being available as it were, in a series of rushes. In reality such difficulty will be of rare occurrence. The necessary element of progression is supplied by one or more of the following factors :—

(*a*) The tenacity of life of sal regeneration which permits great elasticity in silvicultural treatment.

(*b*) *The different treatment necessary in different localities.*

(*c*) The varying rate of development which may be anticipated in these different localities.

(*d*) The intervention of local seedling years.

68. If there were any difficulty it would be found in a regeneration block consisting entirely of the dry type of the forest, with little *kokat* or underwood. It has already been pointed out that in such we cannot interfere with the natural course of events to the extent possible in the moister tracts. Our policy is perforce negative—our aim being to prevent *rather than to* promote—and the only check on grass growth being shade, a periodic segregation of fellings may sometimes be unavoidable.

* This is now being resorted to in Haldwani Division.

69. The conversion of "mature" areas, of course, can always be delayed at will, so that a suitable gradation of crops in the future need never present any difficulty.

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8th March 1927.

AN ATTEMPT TO CORRELATE THE GEOLOGY AND FOREST TYPES OF NORTH CHANDA DIVISION, CENTRAL PROVINCES.

The distribution of forest types in any locality is governed by a series of factors acting and interacting on each other. And of all the influences governing the distribution of forest types in this division that due to human agency is the most predominant and being mainly erratic renders all efforts to understand the proper significance of other influences very difficult. The extent of human interference can be judged from the fact that right in the middle of forests, which are often regarded as primeval, sites of deserted villages with human associates like *Ficus religiosa* and *Tamarindus indica* can be found. An attempt is here made to study the distribution of forest types in relation to geological formations, due consideration being paid to other factors as well.

For the purposes of this article the following local types are adopted :—

(*i*) Pure teak.
(*ii*) Mixed teak.
(*iii*) Mixed forest.
(*iv*) Salai.
(*v*) Bhurra-Gongal.
(*vi*) Rohan.
(*vii*) Thorny forests.

It must be remembered that only the main types of forest found in the division are adopted, the variations in the composition of the crop in one type due to the relative proportions of sand and clay or other variations of soil are not considered.

Classifying the rocks of North Chanda division in descending order there are :—

Aryan Series...	(*a*) Recent deposits consisting mostly of alluvium.		
	(*b*) Laterite.		
	(*c*) Deccan trap	(*i*) Trappean Series	
		(*ii*) Infratrappean group.	
	(*d*) Gondwana	Talchir.	
		Barakar.	
		Kamthis.	
Puran Series...	(*e*) Vindhyan	Sandstone.	
		Shale.	
		Limestone.	
Archæan Series (*f*)	(*i*) Granite.		
	(*ii*) Gneiss.		
	(*iii*) Dharwars.		

Of the Gondwana Series Talchirs occupy only a small area in this division and bear a poor miserable open crop; the Barakars, although of great economic importance, just appear in one place. Of the Archæan Series Dharwars are represented only by an out crop from Wairagarh to Visora. The forest in this part has suffered so much maltreatment that it is dangerous to attribute its existence to geology and soil, or to base any other conclusions on it.

Hence the important formations found are —

(1) Alluvium including laterite.
(2) Trap.
(3) Kamthis.
(4) Vindhyan.
(5) Granite and Gneiss.

(1) *Alluvium and Laterite* :—Alluvium is found only in small patches and has no importance for our purposes. Laterite may exist in definite strata as in patches round Bramhapuri, but more often it constitutes the overlying soil—a laterite murram frequently as a capping to the hills. The main importance of laterite lies in the fact that it considerably modifies the character of other

rocks, and this will be dealt upon under the respective geological formation. Patches of pure *Cleistanthus collinus* are the remarkable feature on well disintegrated laterite.

Soil derived from lateritic decomposition is well stocked both when overlying the Kamthi sandstone and the metamorphic rocks.

(2) *Trap formation.*—The main type found is '*Pure teak*'. As a general rule soil is of no great depth and although teak is remarkably plentiful it is of poor quality. The absence of *Pterocarpus Marsupium* is remarkable. Along the slopes and in the vallleys climbers are very bad, the most important being *Zizyphus Oenoplia.* Fodder grasses, *e.g.*, *Iseilema* species and *Ischæmum pilosum* are common.

Black cotton soil is frequently associated with trap. Where the black loam overlies the trap as in parts of Warora range it is doubtless the true black cotton soil, but most of the black loam of Chanda appears to have been derived from the disintegration of hornblende schists, which consists chiefly of silica, alumina, lime and oxide of iron. '*Thorny forest*' is especially characteristic of black cotton soil overlying trap and consists of *Acacia arabica, Acacia leucophlæa, Acacia Catechu, Butea frondosa, Zizyphus xylopyra, Zizyphus Oenoplia, etc. Anogeissus latifolia, Gardenia turgida, Dichrostachys cinerea* and *Balanites Roxburghii* are also common. The common grasses are *Iseilema* species and *Heteropogon contortus*, etc. Owing to maltreatment the forest is often reduced to a miserable growth of *Diospyros Chloroxylon, Dichrostachys cinerea, Gymnosporia montana, Zizyphus Oenoplia, Calycopteris floribunda, Celastrus paniculata, Ixora parviflora,* and *Balanites Roxburghii.*

(3) *Kamthi formation.*—The rocks comprising the Kamthis are—

(*i*) Grits.

(*ii*) Sandstones, coarse or fine grained.

(*iii*) Sandstone argillaceous and ferruginous.

Clays usually red and green and shales of various colours occur intercalated among the sandstones. There is a general easterly dip but not at a high angle and over many miles the ocks are nearly horizontal.

The main types of forest found are '*Mixed teak*' and '*Mixed*' type*. The crop in the latter type consists of the usual Central Provinces species.—*Pterocarpus Marsupium, Terminalia tomentosa, Terminalia belerica, Terminalia Chebula, Terminalia Arjuna* (along streams), *Anogeissus latifolia, Cleistanthus collinus, Phyllanthus emblica*, etc., with a dense undergrowth of bamboos all over. The climbers are numerous and abundant the chief being *Zizyphus Oenoplia, Calycopteris floribunda*, and *Butea superba*; *Zizyphus xylopyra* and *Dodonæa viscosa* are fairly common. When cotton soil, clay or laterite overlies this formation the growing stock is fairly dense. If, in addition, the area is well drained and the soil contains a fair proportion of loam the '*Mixed teak*' type appears. The mixed type varies considerably from a fairly high forest on the richer soils to open low poorly grown woods on the iron or lime infected soils south of Chanda.

(4) *Vindhyan formation.*—This formation is characterised by a low plateau with steep escarpments. It consists of—

(*i*) Sandstone and semiquartzites,
(*ii*) Shales,
(*iii*) Limestone.

The shales are intercalated with limestone. The most pronounced rocks in this group are the fine-grained vitreous sandstones with a uniform or splashed pink colour, the brownish sandstone and the purplish shales and quartzites.

The forest types found on this formation are:—

(*a*) Mixed teak,
(*b*) Mixed,
(*c*) Salai,
(*d*) Bhirra-Gongal,
(*e*) Rohan.

(*a*) The '*Mixed teak*' type normally consists of teak, *Pterocarpus Marsupium, Bombax malabaricum, Terminalia tomentosa, Stephegyne parvifolia, Dalbergia paniculata, Diospyros Melanoxylon, Anogeissus latifolia, Buchanania latifolia, Lagerstrœmia parviflora, Aegle Marmelos, Cleistanthus collinus, Chloroxylon Swietenia,*

* As the '*Mixed teak*' and the '*Mixed*' types occur on the Vindhyans also, they are described in greater details there.

Bassia latifolia, *Sterculia urens*, etc., and occasional *Dalbergia latifolia* and *Adina cordifolia*. The undergrowth consists chiefly of *Holarrhena*, *Grewia* and *Helicteris*. The climbers most common are *Butea superba*, *Bauhinia Vahlii*, *Calycopteris floribunda*, *Zizyphus Oenoplia* and *Vitis* species. As a rule these forests contain a very thick undergrowth of bamboos, which renders regeneration difficult; but the bamboos disappear from the Kasarbori block (where they are confined to the western slopes of Ramdegi Pahar). The reason for this disappearance is not at all clear. A number of grasses are found over this formation, *Iseilema Wightii*, *Aristida setacea*, *Anthistiria laxa*, *Heteropogon contortus* and *Eragrostis interrupta* being the common ones *Ischaemum laxum* is the common grass on the Kasarbori plateau.

(*b*) '*Mixed forest*' type is found in places which are not suitable for teak possibly due to an absence of loam, or due to defective drainage. The crop here consists of all the species mentioned above with the exception of teak. *Gardenia lucida*, *Gardenia gummifera*, *Gardenia turgida* and *Randia uliginosa* are very common over the dry rocks of Ghorajhari. There is a close association between teak and *Pterocarpus Marsupium* everywhere, but the latter thrives with a lower percentage of loam and can tolerate more defective drainage, hence it is common even in the '*Mixed*' type.

(*c*) The '*salai*' (*Boswellia serrata*) and '*bhirra-gongal*' (*Chloroxylon Swietenia* and *Cochlospermum Gossypium*) types are the local representatives of xerophytic forest formation. *Boswellia serrata* is found scattered here and there in '*Mixed teak*' and '*Mixed*' types, but the '*salai*' type occurs mainly on dry ridges. It consists of an almost pure crop of *salai*, growing as an open crop associated with *Cochlospermum Gossypium* and *Sterculia urens*. Shrubby undergrowth is non-existent here and the grasses are mainly species of *Aristidia* This type is very common on the horizontal beds of shales.

(*d*) '*Bhirra-gongal*' type consists of an open crop of *Chloroxylon Swietenia* mixed with *Cochlospermum Gossypium* and *Sterculia urens*. It is common on the plateaux and the eastern sides

of the Taroba hills. Occasionally the proportion of *Cochlospermum Gossypium* in the crop of this type is very high.

(*e*) '*Rohan*' type consists of an almost pure crop of *Soymida febrifuga* and is mainly found on lime-infected water logged areas or loamy areas which have been under cultivation. It occupies only a small area and deserves mention mainly because it is probably the precursor of better forest types.

(5) *Metamorphic rocks.*—As pointed above these rocks consist in North Chanda division mainly of granites and gneisses. Granites typically composed of quartz, felspar, mica or hornblende are in this division associated with diorites and other holocrystalline basic rocks. Gneisses consist of gneiss proper with schists or hornblende, mica quartz with much vein quartz.

Quartz schist produce a stony unfertile soil and bear scrub jungle. On gneiss with felspar the forest is reduced to thorns especially *Zizyphus Oenoplia*.

The black loam overlying the gneiss and mainly derived from the disintegration of hornblende schists contains the '*Pure teak*' type without bamboos. This type is found along the left bank of the Wainganga. The whole forest here lacks height and vigour, the trees are stunted, crooked, and stag-headed and the ground is ill-drained. Most of this area seems to have been some time under *juari* cultivation.

Laterite occurring over metamorphic rocks improves the fertility of the soi. and here '*Mixed teak*' type without bamboos is found, wherever drainage is good. Where drainage is not so good it gives place to the '*Mixed*' type consisting of a dense growth of *Cleistanthus collinus, Phyllanthus Emblica, Buchanania* and *Terminalia*, etc. Several grasses are found but *Ischaemum angustifolium* is the common grass on the metamorphic rocks. The common climbers are *Zizyphus Oenoplia* and *Calycopteris floribunda*, etc. After the detailed examination of the forest types and rocks of this division the following conclusions are arrived at :—

(*i*) The best teak is found on the Vindhyan sandstones and shales and to some extent on Kamthi sandstone.

(*ii*) Good teak occurs on the metamorphic rocks when capped with laterite.

(*iii*) Bamboos occur only on the sandstone areas.

(*iv*) On sedimentary rocks it is the physical and not the chemical nature of soil which determines species

(*v*) Teak can be seen wherever the geological conditions are favourable to it and if teak does not exist anywhere it is certain that the geology of the locality is not suited to it.

(*vi*) In localities geologically suitable to teak it is capable of regenerating itself, but the regeneration is being suppressed by the dense growth of bamboos which owe their existence to human interference.

(*vii*) There is progressive improvement of the soil by the disintegration of rocks and accumulation of leaf mould, etc., and under this improvement the more exacting species like teak are displacing the more accommodating like *Diospyros Melanoxylon*, *Sterculia urens*, etc. Human interference in the form of fire protection is upsetting this progressive succession.

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THE PLANTATION PROBLEM AND ITS SOLUTION IN UPPER ASSAM.

1. At the outset it may be safely said that Assam is not short of forest areas, but what it is really short of is forest wealth. For a very long time it was believed that our reserves contained magnificent tree-forest, until a few years back, as a result of *enumeration in some of the divisions, it was* discovered that what we believed was wrong. If imagination is not to take the place of reality, such a timber famine, as would compel men to buy any and every timber at any price cannot be predicted. If, therefore, the revenue is to be maintained or the value of the forests enhanced the vast areas of land now covered with unmarketable and miscellaneous species will have to be planted up with more valuable trees. Most of the species, at present, have no other value except fire-wood.

2. Plantations purely artificial, run more or less on the lines of tea-gardens, appear to be the only solution of the problem for the present. *Taungya* or semi-*taungya* is still out of the question in many of the divisions, as land-hunger in its true sense is still unknown in Upper Assam. It is only recently that emigrants have been allowed to come and settle in the vast waste land still lying unopened in many districts. Our reserve land, however, differs entirely; as much in its topographical character as it is in its titulary aspect, being legally inalienable.

3. It would be wrong to say that attempts were not made in the past to plant up these areas, but the result was invariably a failure. There were various causes, of which the chief have now fortunately disappeared.

(*a*) The price of timber is now much higher than it used to be; this at once justifies a higher cost of formation.

(*b*) The craze for teak has now passed. Whatever may have been the reasons that teak was preferred —it has now been found that most of our indigenous timber trees have better prospects than exotics.

(*c*) A Silviculturist to co-ordinate the work of the different divisions and to formulate a complete scheme has now been appointed.

(*d*) Work was not done in a business-like way, and the silviculture of most of our species was unknown.

4. The cost of formation is the crux of the problem. Bengal spent as much as Rs. 90 per acre at first for sal and mixed plantations with fencing all round. Fencing no doubt raises the cost of the plantation enormously. It is at the same time essential for some of the species like sal and *gomar* (*Gmelina arborea*) and *hollock* (*Terminalia myriocarpa*) which are badly damaged by pigs and deer, but, it is also true that valuable species like *bonsum* (*Phœbe Hainesiana*) and *amari* (*Amoora*

Wallichii) which are immune to the attack of deer and pigs can be grown without a fence; but otherwise exactly in the same way as at Rajabhatkhawa and Sukna.

So fenced and unfenced areas, for species susceptible and immune, should bring down the cost of formation to such a level that the present average price of the main species would permit of an initial expense of Rs. 50 or thereabout per acre for areas close to railway and river.

5. Ring countings of ever-green species is often not reliable but fairly accurate data can be obtained by a little patience. The result of a few ring countings done lately shows that, letting alone *khokan* (*Duabanga sonneratioides*) and *hollong* (*Dipterocarpus pilosus*), most of our species are much faster growing than sal. Therefore the financial rotation will be shorter and would generally admit of a comparative higher initial cost of formation.

6. Before concluding I must point out that the maintenance of big labour forces, such as the foregoing recommendation tends to suggest, is beset with gigantic difficulty. The experience of the planting community of Assam goes to show that recruited labour will only settle down permanently, if they are given sufficient paddy land Like Tea-Estates most of our reserves were made at a time when the prevalent idea was to only include the high land areas and jealously exclude all lowlying areas. Thus there are very few cultivable areas in the existing reserves Tea-garden people, as soon as they felt this pinch, acquired adjoining wet cultivation land and made over these to their labour. But all that we can do now is to remember that in sending up proposals for the formation of new reserves adjoining low-lying areas and grassy blanks suitable for wet cultivation should not necessarily be excluded on the grounds of being accused of land grabbing.

A. K. ADHIKARI, P.F.S.,
In-charge Nowgong division, Assam.

[We suggest that the best advertisement for the above proposal would be to plant 100 acres at a reasonable cost and to publish details in this journal.—ED.]

FAUNA OF BRITISH INDIA-BIRDS, VOLUME III (SECOND EDITION.)

By E. C. Stuart-Baker

The present volume which is well up to the standard of the previous ones, completes the *Passeres* and we congratulate the author on having finished the most difficult part of his work. This Order, as represented in the three volumes now published, contains 303 genera and 786 species or a total of 1,336 species and sub-species, of these the present volume contains 92 genera, 230 species and 291 sub-species.

The volume starts with the handsome Fairy Blue-bird (*Irena puella*), a bird whose position is of some difficulty. Oates placed it in his sub-family *Liotrichinæ* of the *Crateropodidæ*, a sort of dust-bin into which he placed various birds whose position he was not sure about. It is now placed in a family of its own (*Irenidæ*.) which seems the most satisfactory way of settling its relationship.

In the Oriolidæ our old friend the Indian Black-headed Oriole for so many years known as *Oriolus melanocephalus* is now known as *O. xanthornus*. It has been, as the author says, "one of the greatest sufferers from the exigencies of modern nomenclature.' It was discovered that Linnaeus had given it the name of *luteolus*—then it was found that this was predated by another name, the present one, also given to it by Linnaeus. It is to be hoped that it will now be allowed to rest in peace. There is one more thing we should like to mention while considering the Orioles, that is the colour of the plumage in the adult female of the Maroon Oriole (*Oriolus traili*). In the first edition Oates gave it as the same as the adult male but in the present work it is given as streaked below. The late Mr. A. M. Primrose, as long ago as 1911, pointed out, in the Bombay Journal, that out of numbers of carefully sexed adult specimens he did not find a single female in the plumage of the adult male. He was always most careful in any statements he made and personally sexed the specimens which he examined; thus Stuart-Baker corroborates this statement and we thought the

matter was satisfactorily finished. Now those well-known ornithologists Messieurs Jean Delacour and Pierre Jabouille, while describing the results of their second mission to Indo-China in a volume published this year in "Archives d'Histoire Naturelle publiceés par la Société Nationale d'Acclimatation de France," state on page 173.—"Il nous semble que le plumage rayé des parties inferieures soit non pas un signe du sexe, mais de l'âge, car nous avons obtenu une femelle complêtement pourpre en dessous sans trace de rayure. Nous avons aussi des examplaires ♂ et ♀ présentant toutes les gradations entre le plumage rayé et le plumage uniforme." It is well known that some females, at times, assume the male plumage and as, apparently, they only got *one* female in that state we are inclined to think that it was an aberrant one and that the female plumage is as described by Stuart-Baker. Any females we have got have always been striated below.

The Spotted Stare (*Saroglossa spiloptera*) a species placed by Oates in his "dust-bin" is correctly placed in the *Eulabetidæ*.

Two species of Weaver-birds, which Oates wrongly lumped together under one name, the Eastern Baya (*Ploceus megarhynchus*), have in this volume been separated, Finn's Baya, the true *megarhynchus* of Hume and the Eastern Baya (*Ploceus p. passerinus*). It was the latter bird that Oates described as *megarhynchus* and it is extraordinary how he came to make this mistake and confused the breeding cock of *megarhynchus* with bright yellow breast and that of *passerinus* with its fulvous one.

The true Sparrows (*Passer*) have now more than doubled themselves comprising 13 species and sub-species as against Oates' 6; some of those described appear difficult to discriminate. On the other hand the Swallows (*Hirundo*) now only consist of 5 species as against Oates 13, most of the latter being relegated to sub-species which they really are.

In the family *Motacillidæ* Stuart-Baker places the Pied Wagtails as sub-species or *lugubris*, but, apparently, this is wrong as the Rev. F. C. R. Jourdain (Bull. B. O. C. No. CCCX of Vol. XLVII) shows that *maderaspatensis* has priority dating back to 1789, whereas *lugubris* only dates from 1819. If it is

accepted that they are all sub-species then they should stand as sub-species of *maderaspatensis*.

The White-Eyes (*Zosterops*) and Ruby Cheek (*Chalcoparia*) have been placed in families of their own, near the Sunbirds (*Nectariniidæ*). Oates placed them both in his *Crateropodidæ*, the first in the *Sibiinæ* and the latter in his "dust-bin" the *Liotrichinæ*. The present arrangement is more satisfactory.

In the White-Eyes there has been some discussion with regards to the authors sub-species *elwesi* and *cacharensis*. Baker differentiates *elwesi* from *palpebrosa* as "being very much brighter above, more yellow and less green as well as decidedly smaller," but Ticehurst (Bull. B.O.C. No. CCCXII of Vol. XLVII) disagrees with this. He says "It is true there is a brighter yellower form of *palpebrosa* in India but it certainly does not come from Sikkim, and moreover, it is *larger*, not smaller than the Bengal bird." He gives this brighter yellower form a new name (*Zosterops palpebrosa occidentis*) with the type locality Simla. With regards to Baker's *cacharensis*, discriminated from the typical form by its yellow streak down the centre of the abdomen and its being smaller, Tichurst (*loc. cit*) says he has examined the type and in it there is the merest trace of a yellow streak, and that this streak is by no means constant in Assam birds and that the wing measurements of Assam birds come to "just about the range of measurement I find in the typical race,' so he considers it as a synonym of *palpebrosa*. He describes a new sub-species (*Zosterops palpebrosa nilgiriensis*) a larger bird than *palpebrosa* with the type locality as Coonoor.

The author has omitted to give the distribution of the Indian Purple Sunbird (*Leptocoma a. asiatica*).

Both Oates and Stuart Baker have omitted to mention the white spots at the base of the inner webs of the undersurface of the first five primaries in the Blue-naped Pitta (*Pitta nepalensis*). We have examined a good many specimens and they all have it. Besides the lovely "fulvous pink flush on the throat and foreneck" one adult specimen had the abdomen of this beautiful rosy colour.

The Broad-bills (*Eurylæmidæ*) are now considered to be passerine and so are included in this volume. In the 1st edition they were placed in an order of their own (*Eurylæmi*).

The present volume has seven coloured plates, the best of which are, to our mind, those of the Sikkim Yellow-vented Flower-pecker and the Cachar White-Eye. As in the previous the notes on habits and nidification are very full which takes away all dryness of the 1st edition We look forward with much pleasure to the issue of the 4th volume.

C. M. I.

EXTRACTS.

DRUG CULTURE IN INDIA.

Although India is the natural storehouse of a very large number of drugs, and although there is hardly a plant of any importance to which medicinal virtues are not ascribed by the Indians, yet no attempt has been made in India to grow drugs until very recent times. Perhaps the indigenous systems of medicine and pharmacy do not require any special culture of drug plants, the collections made by the village herbalists being sufficient for the purposes of the local physicians There are, of course, a certain number of plants having medicinal as well as other uses, the clutivation of which has existed from a long time past. The most noteworthy among such are those which are officially classified as drugs and narcotics and include opium and Indian hemp. The area under opium is steadily decreasing, and is now not more than 150,000 acres. Before the war Indian opium was arely used for medicinal purposes, but British manufacturers of opium alkaloids began to employ the Indian product by the middle of the period of the war. Investigations regarding the culture of opium poppy since then have shown that the ordinary lower yield of morphine in the Indian opium, compared with the Turkish, is due not so much to climate as to inferior methods of cultivation. In fact, the investigating chemist, Dr Annett, has been able to get by scientific cultivation a quality of Indian opium

containing as much as 20 per cent. morphine, which is certainly not less than that found in the Turkish product. As regards Indian hemp, its acreage has never exceeded 3,000 acres and its cultivation is confined to three centres only, the most important of which is in Naogaon in Bengal. The United States of America is growing some Indian hemp in Virginia, but this has not affected the export of Indian *Cannabis indica* to any large extent. The most important item among drugs and narcotics is, however, cinchona, the total area under cultivation was 7,115 acres in 1922-23. The Bengal plantations account for 3,000 acres, the remainder being in the Madras Presidency. Cinchona is also being planted in Burma, and the Mergui plantation promises bark of a superior quality. Official investigations regarding possibilities of extension of cinchona cultivation have revealed new and suitable sites in the Mikir Hills, Assam and Annamalai Hills, South India, but these are as yet undeveloped. *C. Calisaya*, var. *Ledgeriana*, occupies the largest area in the Bengal plantations, while its place is taken by *C. officinalis* in the Nilgiris Only a small percentage of the area under cinchona has at present come into bearing, but the yield of about 2,700 lbs of bark per acre may be considered to be fair. The quinine content of the bark, varying from 4·3 to 5·19 per cent. is, however, still much below that of 6·34 to 7·54 per cent. of the Java bark. The Tinnevelly district of the Madras Presidency yields a large quantity of senna, but the area under this drug undergoes much fluctuation. Under favourable conditions an outturn of 14,000 lbs. of leaves per acre is obtained. *Cassia angustifolia* is the species grown and the major portion of the crop is shipped to foreign countries through the port of Tuticorin. Among the minor medicinal crops special mention may be made of *Acorus Calamus*, *Aloe vera*, *Datura alba* and *Plantago ovata*.

Medicinal seeds, etc.—Crops officially classified as speices and condiments, have, of course, some medicinal value. Ajowan, anise, fennel, cumin coriander, dill, ginger, etc., possessing aromatic essential oils, come within this class It is very difficult to estimate the area under these, as they are very frequently grown, not as pure but as mixed crops Speaking of crops

yielding essential oils we should not pass over eucalypts, several species of which are now found throughout India. The seat of eucalyptus oil manufacture is, however, in the Nilgiris, where extensive plantations have been made of *E. Globulus* and other species covering a total area of over 2,000 acres. The annual production of oil at present is not more than 30,000 lbs., but rapid improvement is taking place, both in the quantity and quality of the outturn. Another essential oil which deserves mention here is lemon grass oil, obtained from *Cymbopogon flexuosus*. The grass grows wild in many parts of the Madras Presidency, but for distillation purposes the wild stuff is not sufficient, and crops are, therefore, raised in the burnt jungle lands in South Malabar, Cochin and Travancore Some improvement has of late been effected in the quality of the oil by a local process of refining, but the value of the exports has not as yet reached the pre-war level of nearly £70,000 per year. Other grass oils in India are mostly derived from wild sources.

It was the stoppage of foreign supplies during war that directed the attention of the parties interested in drug plants towards the vast resources of the Indian forests, especially of the higher altitudes. For a time there was unlimited exploitation of belladona, hyoscyamus, podophyllum, valerin, colchicum, etc., from North-Western India. This brought about the inevitable result of shortage and undue adulteration of drugs. It became apparent that without supplementing the natural resources by cultivation there was no way of keeping up a steady supply of such drugs. And this lead to the establishment of the few drug farms which supplied these sorts of drugs to the trade during and for some time after the war.

Among the drugs cultivated, belladonna, of course, is the most important. It has been grown at Ootacamund, in South India, Jeolicote in the United Provinces, and near Darjeeling in Bengal, under both official and non-official auspices. Hyoscyamus was formerly cultivated i. the Saharanpur Botanical Gardens from which place it has spread over the neighbouring tracts Henbane is now grown a ong with sugarcane in some parts of the

United Provinces. Digitalis culture is now going on in Kashmir, Bengal cinchona plantations, and the Nilgiris. But while the drug coming from the first two places is quite equal to the best imported, the Nilgiris' digitalis has been found to be wanting in efficacy. The cause of this has not been found out as yet but it has been incidentally ascertained that the physiologically most active preparation of digitalis loses about 20 to 40 per cent. of its potency when stored for any length of time in Indian climate. Ipecacuanha, one of the most difficult plants to grow, has, after years of trial, been successfully raised in sufficient numbers to allow of emetine being manufactured at the Bengal Cinchona Factory. It is also doing well in the Burma cinchona plantation. The cultivation of jalap tubers is well established in the Nilgiris. In spite of the preliminary experiments not being hopeful, good crops of broom-tops, dandelion rhubarb, lobelia, etc., have been obtained by an enterprising firm of drug growers in the vicinity of Ootacamund. The prevalence of hook-worm disease has given an impetus to the cultivation of *Chenopodium anthelminticum* in North-Eastern Bengal, Assam, and elsewhere. The percentage of oil hitherto obtained from the seeds, is, however, not satisfactory, but it is hoped that the introduction of new varieties from America will improve matters.

These are nearly all the drug plants that are or were lately cultivated in India. The general trade depression, which has also affected the pharmaceutical industry, accounts for the abandonment of certain drug-culture enterprises which were in evidence a few years ago. There is, however, no doubt that with the return to normal conditions in the trade a marked want will be felt in the drugs entering into B. P. preparations In the case of nux vomica, the area under which is much larger than that of chaulmoogra, new plantations have become necessary, and a beginning has been made in the Puri district The culture of several important drugs, as the Roman chamomile, gentian, peppermint, etc., has not as yet been attempted. There is a bright future for drug culture in India, if conducted on sound business lines. Moreover, there is no public body, official or non official, to co-ordinate the small endeavours that are being made here and there and to

guide them into proper channels with a view to building up an Indian drug industry. Industrial reconstruction is, however, in the air, and it will perhaps not be long before drug culture as a profitable proposition will attract the attention of Indian capitalists.

[N. B. D.]

[*The Chemist and Druggist, 25th June 1927*]

PRACTICALITY IN FLOOD CONTROL

One of the most important problems pressing for immediate solution by the people of the United States, involving as it does their future welfare and prosperity, is the control of the Mississippi River. Fortunately the need of prompt action is universally recognized. A convention attended by 1,800 delegates —state governors, engineers and influential citizens of varied classes representing many commonwealths—has been considering the matter in Chicago. By unanimous vote it urged President Coolidge to call a national conference for action.

There is lively discussion for and against the necessity of a special session of Congress to deal with the complicated question. There can be no doubt that the energy, enterprise and wisdom of the inhabitants of the great valley and the country at large will find a solution and begin its application as speedily as the great size and many ramifications of the problem will allow.

But there is one phase of the matter that deserves constant consideration in all the discussions of proposed plans, because of its practicality and its relation in the long future to any general plan of control that may be finally adopted, with special reference to its bearing on the ultimate cost of the huge enterprise. That is the reforestation of the headwaters and banks of the thousands of rivulets, brooks and streams of all sizes that ultimately pour their mighty united contributions of water into the great channel that must be controlled.

Many who have discussed the situation have spoken of the forest end of the problem as remote unpractical and only slightly connected with flood conditions. A knowledge of history and the experience of many nations for centuries reveals that this view is

mistaken. France, Germany and other countries of Europe discovered long ago that the forests had close and important connection with the flood problem and acted accordingly. Americans may well profit by their experience.

One glance at a map of the United States on which the streams that flow into the Mississippi are outlined discloses the huge number of the water courses, big and little, that contribute to the great river's flow and the vastness of the territory, stretching from the Allegheny to the Rocky Mountains, that their network covers. Keeping this picture in view and realizing in a measure the enormous volume of water that flows from this area, one may readily see the importance of forests in delaying and regulating the delivery of excess rain to the Mississippi channel.

Right at that point lies the practicality of the reforestation end of the flood problem. Whatever plan of Mississippi control is adopted—higher levees, banks set farther back from the channel, dams and the impounding of large tributaries, parallel canals—any or all these will cost huge sums of money. When that money is expended, there will still be no guarantee that the works constructed will hold the great river at all times and in all emergencies, unless some plan is devised to slow up the flow of flood waters in the great network of small streams in which that water originates. Forests will do this very satisfactorily. They in time will thus insure the efficiency of whatever costly works are constructed along the main channel and its big tributaries.

Objection to the forest plan is made that it is too slow. Necessarily it will take time, but here its practical value again comes in. While new tree plantations, which will ultimately protect the capital invested in great engineering works, are growing, they at every moment with little care or expense will be producing future wealth for the whole country in improved soil conditions and in vast amounts of forest products that the nation is going to be in need of more and more.

A plan that will perform an important function in flood control and at the same time produce great wealth would seem to be a wise one.

[*Christian Science Monitor*, 9th June 1927.]

FOUR PHASES OF FORESTRY.*

BY H. N WHEELER, Chief Lecturer, United States Forest Service.

There are four phases of forestry as I handle the subject. First, forests are valuable from a direct economic standpoint in producing lumber, railroad ties, fence posts, firewood, and hundreds of other things that we use in our every-day activities. Ninety per cent. of the houses of the United States are still made from wood, and 125,000,000 railroad ties are used every year It requires 7,500 acres of timberland to make enough wood pulp for the Sunday newspapers of the United States for just one Sunday.

Watershed protection is the second phase of the subject, and is equally important with the economic destruction of forests, not only in the United States and Canada but also throughout the whole world; it affects the stream flow. Streams are higher in spring and lower in summer and fall where the watersheds have been denuded. The forest acts as a sponge reservoir, preventing too rapid a run-off of surface water, and allowing it to sink into the ground, thus becoming the soil water. China has destroyed its forests over great areas, with resulting flood and famine, and a general lowering of standards of living. This same destruction is being carried on both in the United States and in Canada; if not stopped, it will have the same effect as in China.

The cutting of timber is not the cause of all this, but the *handling* of the *land* after the timber has been removed. Fire, burning, and reburning, has destroyed the young trees that would reforest the areas It has also destroyed the forest floor, the leaf mould that holds the moisture, and that also prevents erosion, Fire has burned the very soil. Prof. A way of the University of Minnesota, says that one inch of leaf mould on an acre of ground contains 800 pounds of nitrogen. It is worth about $ 120·00 per acre spread on the ground, and it is needed if the land is to be cultivated, or if it is to remain in timber. The leaves of one year's production are worth several dollars per acre

* An address given at the opening of the new forestry building at the University of Toronto.

for fertilizer; but the fire destroys the nitrogen ; which is the more important of the several fertilizing elements. So fires are wholly detrimental to every interest. They are nearly all started by human carelessness, and are, therefore, preventable. Cigarr, cigarettes and the matches with which we lighted them, start fires when we throw them from autos and trains, or drop them while hunting and fishing. Campers leave fires, and so do railroads

In the United States in 1924, we burned 29,000,000 acres of land, and in Canada the yearly average is about 3,000,000 acres. We now have in the United States 81,000,000 idle acres that will produce only timber, and we need the timber and need the taxes from these acres in full production. But there are also millions of acres still classed as timberlands that are producing only a fraction of what could be raised on them.

But there is hope ahead. We have 158,000,000 acres in 160 national forests; 32 states are doing something in forestry; 16 states have state nurseries, raising trees, selling or giving them to timberland owners, and 10 states have revised the tax laws so private owners can afford to practice forestry. Private owners are practising forestry by leaving seed trees, by keeping fire out, and by planting young trees. Some of the states have state forests, notably Pennsylvania, with 1,130,000 acres and a $25 000,000 bond issue for future forestry. The Clark McNary Act appropriates money, so that the Government and the states can work together in fire protection, wood ot forestry, and in tree distribution, and taxation study. There are more than 250 cities, towns, and counties that maintain forests on a total of 500,000 acres. We are fighting the blister rust and other diseases; and in addition to the Products Laboratory we have eight forest experiment stations scattered throughout the various sections of the United States. Cities also plant trees along the streets and we have city foresters looking after them.

The third phase of forestry as I touch upon it, is the protection of the wild life. When the forests are gone wild life disappears, and wild life is a real asset to any country or state. People like to see game animals in the wild state, and like to

hunt them. Pennsylvania 20 years ago had little game left; but by the creation of game refuges where wild animals and birds may feed unmolested, and by the arousing of public sentiment favourable to game protection through the creation of game clubs, wild animals have increased so that in the open season of 1924, 929 black bears, 8,000 head of deer, and 5,000 wild turkeys were killed in the hunting season. People go far to see and enjoy wild animals, and there were 10½ million visitors in National Forests of the United States in 1924.

The scenery attracts people, and so the fourth division of my subject is the human use of forests, or *recreation*. Camping, hunting, fishing, or just resting, brings people by the millions into the *forested regions* The tourist business of Canada is the fourth industry of importance in the nation. Forests serve the purpose of recreation in addition, and without extra expense, to the other uses enumerated

Trees beautify our roadsides, streams, and lakeshores. We love them. It was this love of the tree that caused Joyce Kilmer to write that beautiful poem "Trees." (Kilmer died during the war over in France.)

But *fire is the one damaging element, and if we would have* forests for any purpose, we must keep the fire out and grow timber.—[*Pulp and Paper Magazine.*]

THE FORESTS OF CYPRUS.

By Douglas J. W. Hamilton.

Cyprus, an island tucked away in the corner formed by Asia Minor and Syria, is about equal in size to the counties of Norfolk and Suffolk together. Its population is over 300,000 and rapidly increasing, with a density of 86 to the square mile. Although an island, the sea does not seem to have much moderating influence on its climate. The summer heat on the plains in Cyprus is nearly, if not quite, equal to that of Egypt, which is only about 240 miles distant.

The rainfall varies from 15 inches on the plain to 54 inches in the wettest part of the mountains. During six months, from

May to October, practically no rain falls. The rivers are consequently mere winter torrents, which run violently for a few days, and then leave only their stony and deeply eroded beds to mark their existence.

There are two ranges of mountains with an extensive plain between them, but the principal mountain mass is to the south-west, and rises to about 6,400 feet Limestones of various ages cover the largest area, those on the plains being of very recent formation, and alternating with sandstone, some clay, and a very hard conglomerate, which coats the surface of the low barren plateaux. In the highest parts of the mountains there is a large area where the igneous rock, chiefly of serpentine and its related minerals, has thrust its way through the surrounding limestone

The principal forest tree is the Aleppo pine (*Pinus halepensis*), which begins in the foothills and runs up to about 5,000 feet. This tree, a great heat and drought resister, also constitutes a large part of the forests of the south of France. Above the Aleppo pine, the zone of the Corsican pine is reached, where a very sparse forest of old trees exists, with little natural reproduction. These trees are from 300 to 400 years old, and must date from a time when the climate was much more favourable. Reproduction is somewhat better amongst the Aleppo pine, but still far from satisfactory.

With respect to undergrowth, a large part of this is supplied by an interesting evergreen, the alder-leaved oak (*Quercus olivafolia*), a tree endemic to Cyprus. The rest is of the usual Mediterranean type met with in the Italian islands and the south of France, only much more sparse, owing to the greater dryness of the climate. There it is called the "maquis," and in Corsica it shelters the brigands. Its aroma when borne on the sea breeze used to make the great Napoleon homesick. It includes arbutus, myrtle, juniper, rosemary lentiscus, and several varieties of rock-rose or cistus. There are also in Cyprus small areas of native cedar and cypress.

Without tracing the history of the Cyprus forests from classical times, it will be sufficient to give a brief sketch from the

British occupation which took place in 1878 In that year Cyprus was handed over to us by the Turks, but complete annexation only took place during the late war.

During Turkish times everyone did more or less as seemed right in his own eyes with respect to destroying and cutting timber. The forests were denuded near villages and centres of population, and wherever it paid to cut wood and transport it. Often a young tree was cut down, and only a small part utilised to make a pole or a rafter Thousands of felled trees lay rotting in the forest, spreading infection around them. Standing trees were tapped mercilessly for resin, and large areas denuded for the manufacture of pitch and charcoal.

At the British occupation, M. P. Madon, a distinguished French forest officer, was entrusted with the organisation of the forest service. No better man could have been chosen, as his home was in the Aleppo pine forests near Toulon, and his first service was spent in Algeria, parts of which have a climate as dry as Cyprus.

For some time M. Madon was handicapped by the want of maps. Lieutenant (later Lord) Kitchener was just beginning work on his map of the Island. In spite of all obstacles, M. Madon visited most of the forest area, and in two valuable reports recommended that half a million should be spent on re-afforestation. When he saw that little, if any, money was forthcoming, he had the courage of his convictions and left the Island But not before he had introduced Australian wattles and eucalypts, and made a fine plantation of umbrella pine near the Cypriot Salamis.

A number of plantations of eucalyptus and wattles have been made on the plains. These are valuable near centres of population, to provide firewood and for æsthetic reasons. But they do not tend to improve the climate or water-supply, as they suck up far more water than they attract. During the long drought it is extremely difficult to make trees grow, and more than 90 per cent. of each year's seedlings perish. A standing tree is far more valuable to the Island than its timber. The wood of the Aleppo pine, the only tree exploited to any extent in the Island, is of poor quality, and can scarcely compete with imported timber.

It is encouraging to note that the Government has recognised the needs of the Island, and has included in its budget a sum to be spent on planting and sowing. Experiments will be made at various altitudes and according to different systems of treatment. Besides the native trees, it is quite possible that the quick growing Monterey pine and *Cupressus macrocarpa* would do well in some localities is Cyprus. Since one of the principal objects of re-afforestation is to increase the water-supply and regulate streams, attention will doubtless be paid to the catchment areas of the principal rivers. One of these areas was partly denuded by the recent fire, and the effect will probably be felt as soon as the humus begins to disappear. If some plan could be evolved by which the villagers could be induced to plant and take an interest in trees, much might be done to restore the forests of Cyprus to their ancient glory.—[*The Cyprus Agricultural Journal, Vol. XXI, Part 4.*]

WOODEN COCOANUT FRAUD.

Touring with some members of the Corporation the side-shows of Hull Fair, on Monday, the Sheriff of Hull thought he would try his luck at a cocoanut shy Several members of the party followed suit. They scored many bulls-eyes, but the nuts did not fall. A police inspector upon investigation found that the nuts were not nuts at all but wooden dummies with bristles glued to the top They were even planed smooth at the back, and being of heavy wood it would require a hefty blow to dislodge them from the cups in which they were placed.

The gipsy stallholders realised that their fraud had been discovered, and promised to remove the dummies before the general public were admitted. As no money had passed, they could not be prosecuted.—[*Timber Trades Journal, Vol. C, No. 2616.*]

MATCH INDUSTRY IN BIHAR AND ORISSA.

A Resolution on the Annual Report of the Director of Industries, Bihar and Orissa, for the year 1925-26 states that the Match Factory at Gulzarbagh was started in January 1926

but owing to very unsatisfactory supply of wood it did not begin to work full speed until after the end of the year. Between January and March the factory was closed for want of wood for over a month. During this period trials were conducted to prove the capacity of the machines and suitability of the woods available. Several varieties were tested and it was found that of the many species grown in the province *Trewia nudiflora* (*bilour*) was the best both for the boxes and splints, *Odina Wodier* (*jingra*) excellent for box making only, and *Bombax malabaricum* (*simul*) useful for both purposes.—[*Indian Trade Journal, 16th June 1927.*]

EAST INDIA TEAK.

The general tone of the Hardwood market during the month has again been dull, buyers being content, for the most part, to purchase only for immediate requirements.

East Indian teak.—(*Timber*).—Consumption remains very disappointing and, except for some special specifications there is practically no enquiry for shipments to come in. *Planks and Conversions.*—We cannot report any improvement in the demand, but values are firm. Java logs and flitches are in little request, Quotations for ordinary specifications are:—Timber, £23 to £42 (Java, £17 10*s.* to £27); Flitches, £30 to £40 (Hewn Java, £18 to £30); Planks, £24 to £40 (Java, £17 to £28); all at per load on c.i.f. terms.—[*C. Leary & Co.'s London Market Report, 1st to 30th June* 1927.]

FORESTS DESTROYED BY CYCLONE

On Saturday evening, reports the Geneva correspondent of the *Daily Mail*, a cyclone of great violence swept over the Jura Mountains. In the region of Chaux de Fonds, Neuchatel an entire forest was razed as though by artillery fire, and 15 farms in the neighbourhood of the town were destroyed. Roofs were torn off by the gale and carried 50 yards. Trees 100 years old were uprooted and carried away 30 yards. Many animals

perished under the debris of stables which collapsed like packs of cards.

Great tracks of forest were also wiped out on the French side of the Juras. In the Bernese Juras 20 farms were wrecked and an entire forest on Mount Soleil was razed. The thunder which accompanied the cyclone was of such violence that the alarm which was sounded at Chaux de Fonds was almost inaudible. Motorists coming from France were unable to proceed, the roads being blocked by uprooted trees and telegraph posts.

Eye-witnesses say that a whirlwind which moved at extraordinary speed suddenly appeared out of inky black clouds, everything movable being drawn into the vortex and carried a great distance.—[*The Timber News*, *19th June 1926*.]

ANCIENT YEW TREES.

Yews are notably long lived trees, and it is quite possible that the one in Caerhun Churchyard, Carnarvonshire, which has just fallen, has indeed weathered the thousand years with which tradition credited it, says the *Manchester Guardian* There is, however, certainly one other yew still alive, though in fragments now, which can beat even that record. It is the yew of Fortingale Churchyard, in Perthshire. When Pennent visited it, about 1770, it had attained a circumference of over 56 feet, and De Candolle, the famous Swiss Botanist, thought it probably 3,000 years old. Though his mode of reckoning, one foot diameter equalling 144 years, is now thought to give too high results, the most conservative modern estimate gives 1,500 years, and the truth no doubt lies somewhere between. Though the Fortingale specimen has now decayed into two fragments, 14 feet apart, these relics are still in strong growth.

A noted Surrey yew, in Crowhurst Churchyard, is 33 feet round, and has been hollowed out into a kind of arbour-house where 20 people can sit at table. The persistent association of these ancient trees with churchyards has puzzled antiquaries not a little, the most plausible of many theories is that we have here

yet another example of the adoption of an object of pagan veneration by the first Christian missionaries, in which case various local traditions that the trees are older than their churches may be well founded.—[*The Timber News, 18th February* 1927.]

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THINNINGS

We have lately heard a good deal of talk on the subject of thinning *Pinus excelsa* and have ourselves seen very severe snow break in thinned crops; so much so that the opinion has been advanced that thinnings in pine and deodar woods are unnecessary, if not positively harmful. There is no denying the snow damage; but the question "were the thinnings correctly carried out at the proper time" has not been answered; and before the blame can be laid on the thinning it is first necessary to assure ourselves that our silvicultural technique has been correct

The climatic conditions in the Himalayas are not so very different to those of other mountain ranges and the opponents of thinnings are in opposition to the great bulk of accepted opinion. This does not necessarily imply that their opinion is to be derided.

We are as opposed to fashion in forestry as in the wearing of the female hair, but in coming to a decision on any matter it is well to consider all known facts Trowscoed in his essay on thinnings which was published in these pages in *November* 1921 summarises the whole question by quoting the words of the International Congress of Silviculture in 1900 "All struggle between neighbouring stems must be avoided, for it is always at the expense of growth that it takes place. The formation of the stems of the prospective crop in as large numbers as possible, must be assisted by gradual freeing, beginning at an early age. When they are formed they must be thinned out to enable them

to develop their crowns and root systems." In this essay was also pointed out the fallacy of the idea that trees grown under crowded conditions are more rapidly drawn up and attain a greater *length* of bole. Schlich in the third edition of his Vol. II, Manual of Forestry, still seems to imply that the crop should reach the stage of the struggle for existence before the forester interferes and makes a thinning. This text book is also singularly silent on the effects of thinning on height growth. We have lately come across some interesting information on this point. Sir Hugh Shaw Stewart in his presidential address to the Royal Scottish Arboricultural Society stated that the difference in height between plantations of Douglas fir planted 8′ × 8′ and 4′ × 4′ was much in favour of the wider spacing and this confirms the wisdom of the wider planting now carried out. Professor Hawley's bulletin* on the results secured with *Pinus strobus* † in experimental thinning plots during the last 20 years has just come into our hands and is exceedingly interesting. Three plots Nos. 601, 602 and 604 were established in 1905 in pure white pine on a level sandy area of uniform site quality and with fairly common density of stocking and silvicultural condition.

The relative condition of the three plots at the time of establishment may be judged from the data in Table II. The small range between the plots in basal area and cubic contents is particularly significant as indicating their similarity. Table III indicates the treatment given to the sample plots after their establishment in 1905. It will be noted that plots 601 and 602 have been thinned in the same manner each time, the former with a moderately heavy (C grade) thinning and the latter with a light (B grade) thinning. A direct comparison is thus afforded between light and moderately heavy thinnings. Both thinnings have been of the type known as "low thinnings." The light thinning removed trees which were completely or nearly completely overtopped by their neighbours. The moderately heavy thinning took

* Bulletin No 20, Yale University, School of Forestry

† We are well acquainted both with this tree and *Pinus excelsa*; they are similar in appearance, their growth characteristics appear to be the same and there is every reason to suppose that what is true of one would probably be true of the other

all such trees and in addition removed some of the smaller crowned trees from the main canopy.

Plot 604 from which no trees have been cut serves as a basis for comparison with the plots which have received thinnings.

On all plots the slash resulting from each thinning, after close utilization of merchantable material, has been left on the ground to decay.

The tables reproduced at the end show the effects obtained by the different thinnings carried out. The tables giving results in board feet have been omitted as they are of little interest to us.

Professor Hawley summarises the conclusions as follows:

" The experiments must continue several decades longer before final conclusions can be drawn. Careful study of the figures in these tables should indicate the general effects of the thinnings. Tentative conclusions based on the data now on hand are presented in the following paragraphs :—

1. *The thinnings have reduced largely the number of trees per acre*

In the 20 year period from 1905 to 1925 the heavy thinning removed 81 per cent of the original number of trees. The light thinning caused a similar decrease of 75 per cent. The reduction on the unthinned plot, due solely to death of trees from natural causes, amounted to only 32 per cent. of the original number. After the 1925 thinning only 148 trees per acre remain on plot 601, 228 on plot 602 while the unthinned plot 604 still has some 560 stems per acre.

2. *The reduction in number of trees per acre has concentrated growth on fewer stems of larger average diameter and volume.*

The advantage is obvious. Fewer but bigger trees on the area tend to lower logging costs and permit the manufacture of larger sized and often better quality material.

3. *Height growth has been stimulated as a result of the thinnings.*

Starting in 1905 with approximately the same average height of dominant trees the two thinned plots now have higher values than the check plot and have made greater height growth in the

20 year period. The heavy and light grades of thinning (represented by plots 601 and 602) as yet show little difference in height growth.

These figures indicate that height growth may be influenced by the silvicultural treatment of the stand. As a consequence, within the same site class different standards of height growth eventually may have to be recognized.

4. *The actual amounts of material secured by the thinnings are considerable.*

5. *The basal area per acre is considered one of the best indicators of the character of the thinning. Ultimately it may be possible to establish a standard basal area per acre for each degree of thinning, other factors being the same. After and as a result of each thinning the basal area per acre would be reduced to this standard.*

Until the thinning in 1925 no special effort was made to bring the basal areas on the thinned plots to any fixed standard. The basis for selection of the trees had been the crown relations and relative thrift of the individual trees. After the thinnings of 1915 and 1920 the basal area of plot 601 (heavy thinning) was brought down to approximately 100 square feet, while that of plot 602 (light thinning) was reduced to approximately 125 square feet.

In 1925 the two plots were marked for thinning on the same basis of selection as in the earlier thinnings (namely the crown relations and relative thrift of the individual trees). Before the marked trees were felled the total basal area which would be left by the preliminary marking was computed. It was found that very few changes were needed to bring the total basal areas left after the thinnings to approximately 100 square feet per acre for the heavily thinned plot and 125 square feet per acre for the lightly thinned plots.

6. *The annual growth per acre expressed either in feet, board measure, or cubic feet has been increased as a result of the thinnings*

Plots 601 and 602 as contrasted to plot 604 indicate this.

Results during the first four years after the experiment was started (1906 to 1909) contradict the above statement. It is pro-

bable that the beneficial effect of thinning is not always apparent for a few seasons in a stand previously closed.

The periods 1910 to 1915, 1916 to 1920, and 1921 to 1925 each show faster rates of growth in both board and cubic feet on the thinned plots than on the unthinned plot.

A remarkable increase in rate of growth on both the thinned and unthinned plots occurred during the period 1921 to 1925. This increase was particularly large on the unthinned plot, bringing production for this period up nearly as high as the growth on the thinned plots. Differences in climatic conditions between the period 1921 to 1925 and preceding periods are believed to be the cause for the increased growth. Exceptionally favourable climatic conditions not only might increase the total production but might tend to level off temporarily the differences in growth between thinned and unthinned stands.

7. *Thinned stands have a smaller wood capital per acre than the unthinned. Hence even though the growth in amount were no greater yet figured as a percentage of invested wood capital the growth in thinned stands would be far greater. Where, as is usually the case, the growth in amount in thinned stands exceeds that in unthinned stands the above relation of growth to invested capital becomes even more striking.*

8. *The decrease in wood capital resulting from thinnings should be of importance in lessening taxable values.*

9. *The comparatively early financial return secured from sale of material removed in thinnings has a most favourable effect upon reducing the cost of growing a crop of timber as compared to the unthinned stand.* This relation is too well understood to require further elaboration here.

10. *The thinned plots are in more vigorous and healthier condition than the unthinned plot.* This is evidenced by the relative number of dead and dying trees in the various plots. No such trees are found in the thinned plots while they are numerous on the unthinned plot. The trees on the heavily thinned plot appear to be in better condition than on the other two plots. Every tree has an opportunity to expand its crown. In the unthinned plot

the large number of living trees prevents all but the best dominant trees in the stand from securing adequate room for crown expansion.

11. *Pine reproduction is encouraged by heavy thinnings* When the plots were first established in 1905 and for a number of years thereafter, no figures were taken as respects reproduction. In 1920 such records were started. In the spring following each seed year pine seedlings appear in all the plots, both thinned and unthinned. The pine seedlings in the unthinned plot 604 die within a few years and most of them within one or two years.

In the heavily thinned plot the pine seedlings live on much longer and are more thrifty and vigorous. The number of older seedlings living on the two plots is one indication of the fact On plot 601 (heavily thinned) there were in 1925 pine seedlings, five years or older in age, to the number of approximately 6,000 per acre, while on plot 604 (unthinned) there was not a single living pine seedling as old as five years. This is more striking since the number of pine seedlings less than five years of age was practically the same (approximately 6,500 per acre) on each of the two plots.

Whether the present crop of older pine seedlings can continue to live indefinitely under the heavily thinned stand remains to be proven. In any case it appears evident that a crop of pine seedlings adequate in quantity and character to establish a new forest will be always on hand in heavily thinned areas; but in the unthinned area the youger, feebler and less numerous pine seedlings cannot be depended upon to accomplish a similar result.

The lightly thinned plot (602) contains fully as many five year and older pine seedlings as the heavily thinned plot The seedlings on the former plot are less vigorous than on the latter and cannot be expected to live many years longer.

12. *Weighing all factors the heavy thinning is considered superior to the light thinning.* An inspection of the two thinned plots is of value in reaching this conclusion The healthy condition of the stand, the thrifty character and excellent spacing of the individual trees point to the relative desirability of the heavy thinning.

The financial advantages may be summarized by saying that the heavy thinning gives larger returns at each cutting, leaves less wood capital tied up in the forest, while at the same time producing wood at an equal or greater rate than the lightly thinned stand."

A similar series of plots in deodar forest was laid out at Monali in the Kulu division many years ago. The condition of the heavily thinned plot was excellent, that of the moderately thinned plot good, while the unthinned crop was in a more or less moribund condition. The sight of these plots was quite sufficient to convince any one of the value of thinnings. We have reason to believe that the neglect to carry out thinnings in teak plantations has resulted in a permanent deterioration of the crop but would be glad to have this confirmed by some of our readers who have personal acquaintance with this species. We admit that thinnings may do harm but this applies to any silvicultural operation not carried out with skill and understanding; this is no reason, however, for saying that thinnings are unnecessary and should not be carried out.

TABLE I.

Comparison of heights, basal areas, and volumes in cubic feet on plot 604 with corresponding figures from the White Pine Yield Table *

Age of stand.	Average height of dominant trees in feet	Actual basal area in square feet.	Actual volume in cubic feet	Values from the White Pine Yield Table for ages given in the first column — Quality II: Average height of dominant trees in feet.	Quality II: Basal area in square feet	Quality II: Volume in cubic feet.	Quality III: Average height of dominant trees in feet.	Quality III: Basal area in square feet	Quality III: Volume in cubic feet
35 yrs. in 1905 ...	42·1	157·07	3,622·0	44·5	193	4,180	36·0	167	3,100
39 yrs. in 1909	48·3	173·51	4,261·6	50·1	206	4,940	41·2	180	3,644
45 yrs. in 1915 .	52·3	185·09	4,621·2	58·0	221	6,100	48·5	194	4,500
50 yrs. in 1920 ..	55·6	189·9	4,996·4	64·0	232	7,000	54·0	204	5,200
55 yrs. in 1925 ...	60·5	203·94	5,897·6	69·5	241	7,800	58·0	212	5,870

*White Pine under Forest Management, by E. H. Frothingham, Bulletin 13, United States Department of Agriculture, Washington, 1914.

TABLE II.

Comparison of plots 601, 602 and 604.

Plot number	Number of trees	Volume — Board feet.	Volume — Cubic feet.	Mean annual growth — Board feet.	Mean annual growth — Cubic feet.	Basal area square feet.	Diameter* of average tree:	Average height of dominant trees:	Age of stand
	per acre						inches.	feet	years.
601	778	14,664	3,539·0	419	101·0	155·43	6·1	42·9	35
602	920	13,084	3,572·0	374	102·0	151·83	5·5	43·6	35
604	828	14,256	3,622·0	407	103·5	157·07	5·9	42·1	35
Average	842	14,001	3,578·0	400	102·2	154·78	5·8	42·9	35
Range in per cent.									
above average	9	5	1	5	1	1	5	1	
below average	8	7	1	6·5	1	2	5	1	

* As a further test the trees on each plot were separated into four diameter groups, starting with the largest trees and progressing downward. Each group contained the same number of trees with the exception of the lowest groups, comprising the trees of smallest diameter. The diameter of the average tree within each group on each plot was computed. When these diameters for the corresponding groups on the three plots were compared they were found to have a maximum variation of 0·6 of an inch.

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TABLE III.

Record of treatment given the sample plots.

Plot number.	Treatment in year — 1905	1909	1915	1920	1925	Established in year.	Remeasured in years.
601	Moderately heavy thinning	No cutting	Moderately heavy thinning	Moderately heavy thinning	Moderately heavy thinning	1905	1909, 1915, 1920, and 1925
602	Light thinning	No cutting	Light thinning	Light thinning	Light thinning	1905	1909, 1915, 1920, and 1925
604		Check plot unthinned				1905	1909, 1915, 1920, and 1925

Tables of statistical data compiled from the measurements taken on the thinned and unthinned plots.

TABLE IV.

Number of trees per acre in thinned and unthinned stands.

Time	Plot number		
	601 Heavy thinning.	602 Light thinning.	604 Unthinned.
	Number of trees per acre.		
1905 before thinning ..	778	920	828
1905 after thinning	480	556	828
1909	480	556	800
1915 before thinning	460	540	680
1915 after thinning	228	340	680
1920 before thinning	228	340	600
1920 after thinning	202	308	600
1925 before thinning	202	308	560
1925 after thinning .	148	228	560

TABLE V.

Basal area per acre in thinned and unthinned stands.

Time	Plot number		
	601 Heavy thinning.	602 Light thinning	604 Unthinned.
	Basal area per acre in square feet.		
1905 before thinning	155·43	151·83	157·07
1905 after thinning . ..	114·05	113·80	157·07
1909	128·84	129·73	173·51
1915 before thinning	151·30	152·63	184·52
1915 after thinning	97·50	119·86	184·52
1920 before thinning . ..	113·02	131·41	189·89
1920 after thinning . ..	102·45	124·16	189·89
1925 before thinning .. .	126·67	151·04	203·94
1925 after thinning	100·85	125·71	203·94

TABLE VI.

Volume per acre in cubic feet in thinned and unthinned stands.*

Time.	Plot number		
	601 Heavy thinning.	602 Light thinning.	604 Unthinned.
	Volume per acre in cubic feet.		
1905 before thinning	3,539·0	3,572·0	3,622·0
1905 after thinning ...	2,538·8	2,590·8	3,622·0
1909	3,124·6	3,172·8	4,261·6
1915 before thinning	3,973·0	4,028·0	4,621·2
1915 after thinning	2,553·0	3,185·6	4,621·2
1920 before thinning	3,189·2	3,872·4	4,996·4
1920 after thinning	2,912·4	3,668·4	4,996·4
1925 before thinning	3,911·8	4,634·8	5,897·6
1925 after thinning	3,102·8	3,754·4	5,897·6
Total cut in thinnings	3,506·0	2,908·0	.
Total yield	6,608·8	6,662·4	5,897·6
Growth between 1905 and 1925 ...	3,069·8	3,090·4	2,275·6

* Based on all trees 2·5 inches and over in diameter breast high. The volumes in this table are secured by use of Volume Table 26 in *White Pine under Forest Management*, Bulletin 13, United States Department of Agriculture.

TABLE VII.

Mean annual and periodic annual growth per acre in cubic feet in thinned and unthinned stands

	Plot number		
	601 Heavy thinning	602 Light thinning.	604 Unthinned
	Annual growth in cubic feet.		
Mean annual* growth during the year 1905 .	101·1	[illegible]	103·5
Periodic annual growth for the period 1906 to 1925	153·5	154·5	113·8
Periodic annual growth for the period 1906 to 1909	146·4	145·5	159·9
Periodic annual growth for the period 1910 to 1915	141·4	142·5	59·8
Periodic annual growth for the period 1916 to 1920 ...	127·2	137·4	75·0
Periodic annual growth for the period 1921 to 1925 .	139·9	193·3	180·2

*Age of stand for all plots was 35 years in 1905

TABLE VIII

Diameter of the average tree in thinned and unthinned stands.*

Time.	Plot number.		
	601 Heavy thinning.	602 Light thinning.	604 Unthinned.
	Diameter in inches of the average tree		
1905 before thinning	6·1	5·5	5·9
1905 after thinning	6·6	6·1	5·9
1925 before thinning	10·7	9·5	8·2
1925 after thinning	11·2	10·1	8·2

* Secured by dividing the total basal area per acre by the number of trees and finding the diameter corresponding to this average basal area.

TABLE IX.

Average height of the *dominant trees in thinned* and unthinned stands.*

Time.	Plot number.		
	601 Heavy thinning	602 Light thinning	604 Unthinned
1905	42·9	43·6	42·1
1909	48·0	47·9	48·3
1915 . ..	53·7	53·7	52·3
1920	59·5	60·2	55·6
1925	65·1	65·4	60·5
Total highest growth for period 1906 to 1925	22·2	21·8	18·4

* Secured by averaging the heights, taken from height curves for each diameter, of all the dominant trees. The height curves used were constructed partly from measurements of the total heights of trees cut on the plots in thinnings and partly from hypsometer measurements of trees standing on the plots.

SOME DEFECTS IN PRESENT FOREST POLICY.

The official designations selected for the grades of the imperial, provincial and subordinate forest services one and all refer to one aspect of the professional forester's work. It is presumably the primary duty of the five varieties of Conservators, as well as of that important individual, the forest guard, to conserve the forest, whilst an Inspector-General might be expected to have an even more open eye in this respect, and the rangers likewise to scour the forest in their charge with a single view to adequate protection from all forms of injury.

It may reasonably be held that these are mere names laying too much emphasis on this idea of preservation and conservation with a suggestion of putting up a ring fence round every reserve—allowing nothing inside (if possible, not even one of the Forest Entomologist's bugs), and nothing out—not even an extra ounce

of flesh or wool on an innocent kid—and ignoring the important work of making the best use of the forests at the same time. One may go further and assert that this view does exist and has found expression of recent years in the appointment of a number of able officers with a different set of titles referring to a different set of activities -the reference is to forest engineers, logging experts, utilisation officers and so on. Whilst this is only as it should be, it must be admitted that the designations we bear prove that at least at the time of their introduction, the forest services were primarily intended to see to the conservation of forests. It did not and does not require a trained forester to exploit the forests, in fact an engineer with the right experience should do it better and more cheaply, but the belief existed—and we hope still exists—in the minds of those responsible for the administration of the country, that a trained staff is required to manage the forests in such a way that exploitation shall not take place to the detriment of production and productive capacity. As a matter of convenience, the same staff has dealt with the felling and extraction of surplus capital in the form of timber and minor forest products but that should be incidental.

These remarks are by way of introduction as the present object is to draw attention to one or two matters consideration of which suggests that some Provincial Governments and some among ourselves are either intentionally ignoring this primary function of conservation or relegating it to second place.

The first of these matters concerns steps taken or to be taken for the reservation of the forest remnants of the country. It is a matter on which each provincial government acts for itself and one on which it is often very difficult for the proper forest authority to get the administration to see the forest side, and seeing it to act accordingly even in the face of unpopularity or political inconvenience Despite the contrary conviction of almost of every Deputy Commissioner or Collector, no one knows and realises better than the forest officer, the objections the villager has to reservation and the hardships even it may put him to. One of the proofs of this is the fact that the average Forest Settlement Officer, usually with district experience, nearly always

comes round to the view point of his professional associate and is prepared to create reserves where they are required despite the local outcry: perusal of almost any Forest Settlement Report will bear out this statement and there are few better examples than those for the hill tracts all along the North of India with which the following remarks are mainly concerned.

In many districts some reserves were made 40 to 60 years ago: they were as a rule fairly compact blocks fairly well away from the villages and often not much frequented, so that in some cases few or no rights were allowed at all, and in others things were left pretty much in *statu quo* as far as the villagers were concerned. With the passage of time, the difference between what was happening to the forests included in the reserve boundaries and to those outside, could not fail to attract notice. The improvement in the reserves was often surprising even to those who expected improvement, whilst the destruction of the forest outside was often startingly obvious and rapid and its effects on the stability of the hill sides not rarely even more so. With the realisation that this is not in the best interests of those most immediately affected in the destroying agency—the villagers—or in those of the provinces, further steps have been admitted as necessary to check these processes. So far, except that action has dragged far behind the proper time for it, all this is in the right direction, but the question it is wished to raise here, is, are the right steps being taken? As stated the realisation has been reached that it is necessary to put a stop to the destruction of the trees on waste land or forest (if still deserving the name) not yet reserved or effectively protected, and if possible to turn the scale and restore some of the already denuded areas. For what type of land is protection most urgently called? Surely the areas where final destruction has already taken place or is most closely threatening. it seems too evident to need mention. But what has been done time after time? The best stocked and most out of the way areas are selected and to them protection is extended, commonly with complete relaxation of control over the remaining parts. There can be and there is only one result. The destructive agencies referred to are con-

centrated on the unprotected remnants and their early annihilation is assured.

An awful example is one in which the only policy which could be accepted by the trained forester was courageously acted upon by a Forest Settlement Officer some years ago and forest remnants threatened with destruction were reserved and the attempt made to conserve them for future generations. There is a political agitation as a result of which this sound policy is thrown overboard and many of these areas so urgently in need of careful management to ensure their very existence, are disforested—it is believed in some cases in the literal as well as the legal sense of the word. It is almost incredible that the fact should require mention that less harm is done by indiscriminate fellings in a fairly, well stocked forest, than in a very open one, but it seems to be ignored every time forest reservations are under consideration in these hill forests and every time a former forest settlement is interfered with. It is also surprising that after countless examples in all parts of this and other countries, administrators refuse to learn the lesson that a rural population will never agree willingly to any check on their destructive usage of forests accessible to them and good government necessitates protecting them against themselves. Everyone has seen the final results in the desolate and bare landslip scored hill sides visible from almost every hill station. Commonly the original valley bottom type is lost beyond remembrance, and in many the whole *Pinus longifolia* zone has disappeared from below higher level types, or the hills are bare to their crests.

To summarise, we require to be very clear as to whether our policy is to be that we should urge reservation only of those forests which can, at least in the near future, be definitely revenue producing. If other considerations are to be allowed to come in, ought we or ought we not to urge every government to protect the villager against himself however much he may object by extending protection first to the nearest and therefore most threatened areas. The writer feels that our profession could do with some extremists, as vociferous as the best, to enforce attention being given to this matter.

The second way in which the conservation idea is being seriously lost sight of, and this time by us forest officers ourselves, for as it will be seen we cannot pass on the blame to the civil authorities or politicians, is concerned with the broader significance of the term. Can we truly say that during the last quinquennium or decade we have in no important case exploited our forests to such an extent or in such a way that regeneration with its promise of future crops has failed to take the place of what we have removed? Have we always made even fairly sure that regeneration will follow methods decided on for the removal of mature or possibly overmature growing stock? It would be difficult for any province to answer this with an unqualified affirmative although it is fortunately a fact that attention is being given to the point in some cases, *e.g.* with deodar where regeneration has fallen behind the felling and also where artificial regeneration has provided a solution (teak, sal in Bengal, etc.). All over the country we have examples of heavy fellings being continued year after year—often under working plan prescriptions which are supposed to result in the springing up of regeneration either from seed or advance growth, but which do nothing of the sort. Outstanding examples are many high level coniferous forests, some types of sal and teak forests and above all, our evergreen forests. The solution is not easy: usually we have overmature stock which ought to be worked out, and we feel entitled to some revenue from such forests. The quasi-solution which is commonly adopted is to say that silvicultural knowledge has fallen behind hand, that other things cannot be held up any longer, and so to call the exploited coupes "experiments."* This is usually justified by saying that after all in the year or two during which the necessary silvicultural knowledge of regeneration operations will be obtained, the area worked over will be relatively small. But is this good enough? Can one not think of forests where five or more annual coupes have already been made and the knowledge is still wanting? Have the necessary experiments always or even usually been carefully initiated and

*Mr S. H. Howard has ably described the scale and stages of required investigations of this kind.

watched? It is a matter of common experience that in regeneration operations, ultimate success depends very largely indeed on success in the first season after the main fellings: poor results then and still more, delay of one or more whole seasons, is commonly fatal, and the problem of dealing with the old non-regenerated felled-over areas is liable to be a very difficult one indeed and quite a different one. It will surely be admitted that we ought to discover how to regenerate *before* we alter the whole condition of the forest by concentrated fellings, and we have rarely done so.

It is conceded at once that the above is destructive criticism and its logical conclusion is that fellings ought to be held up for an indefinite period till experimental work has given conclusive favourable results—which is not as a rule a practical proposition. What can be done is firstly to avoid launching new schemes which must result in fundamentally altering conditions in the forest beyond restoration, and secondly to realise that productive experimental investigation and successful regeneration work both require staff and time. We require to act on the realisation instead of diverting even more of the little time available to Divisional Forest Officers and others by saddling them with heavy work and responsibilities with departmental extraction schemes. One may even venture to suggest that successful regeneration is more important than the selection of a formula for calculating the outturn or the compilation of yield tables to show how the crops will develop when we have got them. It is a most *gratifying* sign of awakening in this matter that nearly all provinces now have their research branch, but only too often the amount and scope of the work needed and its difficulty is not realised to judge from the staff allowed and the way results sometimes seem to be expected 'to order' none the less. Other essentials frequently disregarded are that the research staff must remain at that special work for a reasonable period, as short term appointments can only bring discredit to the incumbent, to the work and to the profession, and also that the staff must be well experienced in routine divisional work.

Here then is the second urgent question on which a clearly defined policy requires to be formulated and acted on: ought we

to change our silvicultural systems and particularly to start concentrated fellings on anything more than a small scale without *first* ascertaining that regeneration is assured ? If we ought not to do so, then ought we not to consider it a first and immediate necessity to appoint an unquestionably adequate staff with adequate facilities for a thorough investigation of the soundness of the introduction of such changes.

This leads on to a third but very closely allied question which would hardly require mention were it not that more than one recent example could be quoted in which attempts to act on the apparently obvious answer have been frowned on to say the least of it. It is: ought we to wait till the urgency arises before we allow our research staffs where we have them to investigate regeneration and allied problems ? The whole point is that most such investigations cannot give conclusive results in a few years, and a few days' work and a few rupees expenditure now may easily mean ten years saved ten years hence. Having admitted above that we are behind hand in nearly all these things, it is obvious that attention must be concentrated on the urgent demands, but even so, the opportunity often arises of initiating an experiment on a less urgent one without hindering progress with the others It may be no more than demarcating a plot and recording its exact condition. Should not zeal of this kind be encouraged within limits rather than form the subject of reprimand ? We all know of forest problems which though of little relative importance at the moment, must obviously become so in the course of a decade or two ; if we did not, we should have to plead guilty to a charge of stagnating.

The fourth and last problem it is proposed to raise here mainly concerns the exploitation of our dwindling stocks of as yet unworked forests. Opinion does and will continue to vary between wide extremes. The question is as to whether it is advisable to commence operations in these forests directly the resultant income will leave a margin over expenditure. If we can get a royalty of say one anna per c ft. should we at once commence operations on a considerable scale, or should we say, 'no, one anna is not good enough ; we will hold on till we can

get four annas'? The answer will justifiably vary with conditions but it is the considered opinion of the writer that in many cases we are guilty of a serious mistake in having commenced such operations. Examples at the two ends of the scale will show the reasons for this opinion. On the one hand we have forests in remote hill tracts where extraction to the nearest market, actual or prospective, will inevitably cost nearly as much as the timber is worth and a higher royalty cannot be hoped for in the course of a period which will be a large portion of any likely rotation, here we are justified in felling and regenerating as soon as there is a workable margin of profit. On the other hand, we have extensive forests full of large timber in relatively easy country not yet much opened up but quite capable within a few decades of experiencing a radical change with the coming of railways and roads, development of mineral resources, extension of cultivation on what ought to be arable land, and so on. Here one would think that there should be no question but that exploitation should be limited to clearing areas required for cultivation villages and works, and the rest of the forest held for the little while longer. To give out leases on fixed nominal royalty for long periods of years over wide areas of forest seems almost criminal, and totally unjustified by the common excuses of opening up the country, of necessity to start new industries such as plywood, etc., but it is done. The arguments against it are strengthened tenfold by what has been written above concerning the necessity *of making sure there is another crop of* the desired species coming up in the place of the one removed, a necessity which has rarely if ever been considered in the examples in mind. Exploitation of an existing virgin crop under such conditions, often for a miserable return can never find justification on the grounds of a "opening up the country." If this country is going to "open up," it will do so without such attempts at hastening and if it is not going to without them, it won't with them. Similarly, a new industry may require a guarantee of supplies for a period of years, but not a price fixed regardless of eventualities, and if there is little chance of any reasonable return coming to the forest though it may be to

industry, why should the forest be sacrificed to the industry's hurry for profits?

Finally, it will not escape notice that whatever opinions may be held on the subjects brought up in this article, they lead to the conclusion that despite recent developments we are still very behind hand with our silvicultural investigations and ought to remedy this at once, also that if the professional advice of our higher forest officials is turned down by the administrations, the fact and the representations made should not only be recorded (as is already done in some cases) in official "Proceedings," but ought, in justice to our profession as a whole, to be repeated in more widely read publications such as the annual administration reports, and repeated annually, if necessary.

CAMP HAZARA: 12th June 1927.

H. G. CHAMPION,
Deputy Conservator of Forests.

ARTIFICIAL REGENERATION OF SAL BY TAUNGYA IN GORAKHPUR, U P.

I.—DISTRIBUTION OF LAND.

1. When the clear fellings are over, areas which definitely fail to regenerate themselves by means of coppice are let out to the cultivators for raising field crops along with sal (*Shorea robusta*). The villager sets to work on this area at the end of April He burns all the felling debris and prepares the field. Small stumps are dug out during the soil preparation, but the bigger stumps are left to be dug at leisure, when they are burnt into charcoal in small pits and sold locally.

2. It is important that no man should get more land than what he can cultivate with ease. Generally, one family consisting of three to five members is allotted a couple of acres to cultivate. Fields are so arranged that each cultivator has to dig an equal portion of the fencing ditch 3′ wide 4′ deep. (*Vide* photograph of the ditch, *Indian Forester*, March 1925).

3. At the break of the monsoon, the villagers raise a *kharif* crop. Sal seed is not sown the first year. During their leisure

hours towards the end of the monsoon season, they dig out all stumps and convert the area into a proper field. *Kharif* is followed by *Rabi*, which is reaped by the middle of April next. Thus, in the first year the cultivator raises his own crops exclusively and in return digs out stumps and prepares the soil. This year is, therefore, called the "preparatory" year in which the land is cleared, aerated and sweetened by raising two field crops. Sal is sown the next year at the break of the rains. Cultivation is allowed for three years more.

II.—SOIL PREPARATION FOR SAL SOWING.

4. The field is usually well worked during the first year and all stumps are removed from the area. During the following hot weather, *i.e.* in April and May, the cultivator is asked to prepare beds in lines 12" wide and 12" to 15" deep. This work is usually finished before the 15th May; and the earth so dug is heaped alongside the bed. The idea is that the soil should be allowed to aerate thoroughly and bake under the summer sun. By the end of May these beds are again filled up by the cultivators. It is essential to inspect the beds before they are filled up for obvious reasons. After that we have nothing to do till the rains break. During the interval the cultivator prepares his own field between the lines of sal beds.

5. The distance between the lines has been systematically reduced from 18' in 1923 to 10' in 1927. In the beginning the cultivator would not agree to a distance less than 18 feet. He believed that 18' was the very minimum space in which his plough and roller could turn round in the preparation of the field and we had to agree to his terms reluctantly. But as years passed by and the cultivator prospered, he allowed us to diminish the distance between the sal lines in each fresh area, until it has been reduced to 10' in four years. If, however, later experience proved that even 10' was too far apart, we are confident now that we could make the cultivator agree to even 8' spacing. The difficulty of turning the plough and roller was overcome by ploughing the fields in alternative strips between sal sowings. This device affords plenty of space for turning round. Sal lines are laid out along the contours.

III.—SEED COLLECTION AND SOWING.

6. It is scarcely necessary to emphasise the necessity of sowing fresh seed. In *taungyas*, however, our great problem is the collection of a lage amount of seed in a short space of time within which it must be sown. The trees bearing fruit are, therefore, marked out beforehand in the vicinity of the plantation and batches of cultivators are allotted separate areas from where they shall collect the seed at the break of the rains. As soon as the monsoon sets in, seed is collected and sown as far as possible on the same day. Sowings are done in two rows 4' apart, and the seed is placed 2" apart in each row. One row is sown shallow with wings just protruding out of earth, while the other row is sown 1" to 1½" deep. Deep sowings are resorted to bridge over a gap in the monsoon. Deep sowings naturally take longer to germinate but come in very handy when there is a long break in the monsoon which kills all shallow sowings.

IV.—DEVELOPMENT AND TENDING.

7. Germination usually takes place within a week. After sal sowings are over the cultivator sows his field crops. A weeding is usually found necessary about a month after the sowings The first weeding mainly consists of uprooting grass from the sal lines and is carried out in such a way as not to disturb the germinating seed. Second and third weedings are done in the beginning of September and in the first week of October respectively. By the end of October the sal seedlings are about 6" to 9" high with 4 to 8 leaves, and a peculiarity of the *taungya* seedling is that it continues to grow throughout the year, except when there is a touch of frost.

8. Pigs are a great danger to sal. They spare neither seed nor seedlings. A pig proof ditch is, therefore, made by the cultivators which for an area of one hundred acres would cost if done departmentally, about Rs. 500. As it is the cultivators dig the ditch to protect their own crops from wild animals and the sal seedlings are protected incidentally. When seedlings have survived the first growing season they are comparatively free from pig-damage.

Fig. 1.—Sal *taungya* coupe 2, West Lehra block, four season old sal.

Photos by M. Shaukat Husain.

Fig. 2.—Sal *taungya* coupe 2, West Lehra block, three season old sal.

Fig. 3.—Sal *taungya* coupe 3, West Lehra block, two season old sal.

Photo by M. Shaukat Hussain.

Fig. 4.—A closer study of four season old sal of coupe 1, West Lehra block.

The measurements of height growth of sal are—

After first growing season		6" to 9"	November	1923.
After second	,, ,,	1½' to 2½'	,,	1924.
After third	,, ,,	3' to 5'	,,	1925.
After fourth	,, ,,	6' to 10'	February	1927 (this is the year after which the *taungya* is abandoned).

I have already described the field crops grown in sal *taungyas* in an article published in the *Indian Forester* for May 1925. The expenditure incurred by the department over *taungyas* is about one rupee per acre, which mainly consists of the pay of watchers and in some cases the carting charges of seed when it has to be brought from a long distance. The fencing ditch, as we have seen, is prepared by the cultivators without any cost to the department. The cultivator is allowed free grazing for plough cattle, thatch grass and a few *kokat* poles for the erection of his hut on the field.

SHAUKAT HUSSAIN,
Forest Ranger,
Gorakhpur.

NOTE ON THE WILD BIRDS AND ANIMALS PROTECTION ACT VIII OF 1912.

1. As the name shows, the Act aims at ensuring protection to wild birds and animals, and applies to all lands throughout British India.

2. So far as the Reserved Forests are concerned, the Indian Forest Act makes adequate provision for the protection of the birds and animals within their limits, but the moment those limits are crossed into the adjoining lands, that protection ceases to operate. It is, therefore, as much in the interests of the birds and game in the Reserved Forests as in other lands, that the following remarks are offered.

3. The provisions of Section 3 of the Act declare certain acts to be unlawful, and Section 4 prescribes the penalties for those acts. Section 5 vests in the trying Magistrate the power to

confiscate, and Section 6 deals with the jurisdiction of Magistrates to take cognizance of offences under the Act. It is, however, nowhere laid down as to *who is to move the machinery* of the law in the first instance. There is clearly an important link missing between Sections 3 and 4, inasmuch as the Act does not provide as to the agency of detection and bringing the offenders before the Magistrates. It is plain that Magistrates will *seldom be enabled to detect offences* themselves and proceed *suo motu.*

4. Offences may either be (1) Cognizable, or (2) Non-cognizable.

A cognizable offence, as defined in Section 4 of the Criminal Procedure Code, " means an offence for which a Police Officer " (or any other officer specially empowered in that behalf) " within or without the presidency towns, may, in accordance with the second schedule, or under any law for the time being in force, arrest without warrant."

Dealing with the second schedule above referred to, offences under the Wild Birds and Animals Protection Act fall under the category of " Offences against other Laws" under the Schedule " punishable with imprisonment for less than one year or with fine only, " for which " arrest without warrant" is not provided. As regards the Act itself, that also does not provide for such arrest. The offences, therefore, are not cognizable, but essentially non-cognizable which the Magistrate may take cognizance of on a complaint.

5. The points, then, to be determined are on whom does the duty of making a complaint devolve, and what is the penalty under this or the other existing laws for failure to discharge that duty.

6. Section 176 of the Indian Penal Code provides punishments for omission to give information of offences, but its essential condition is that the person committing such omission should be one legally bound, either under a special law or the general laws, to give such information. In the present instance, the Act binds no persons in that behalf, while none of the acts prohibited

by it fall within the purview of Chapter IV of the Criminal Procedure Code, which specifies where persons are bound to give information.

7. It looks, therefore, that the Act contemplates leaving it to the good sense of the people, whether public servants or others, to detect and report offences. If so, there still arises another question. Assuming that a conscientious citizen did take it upon himself as a matter of moral duty, to lodge a complaint, would the trying Magistrate always find it possible to believe it. The complainant has no power to seize the articles with regard to which the offence is alleged to have been committed, and the complaint, therefore, must usually be without the chance of these essential ingredients of the evidence being produced in Court. Obviously, the Magistrate must find his task difficult, as he has not always to deal with people whose word can be accepted as a guarantee of truth.

8. It would thus seem that the Act as it reads is anything but effective, and it is suggested that the Legislature may remove its disabilities in the light of the above remarks.

9. While this is so, certain other suggestions also offer themselves and might as well receive consideration. One relates to the destruction of animals over water.

It is a patent fact that advantage is commonly taken of the few water-holes left in the areas at certain times of the year, which the animals resort to in the exercise of their nature's right to quench their thirst, but are frequently served with death at the hands of unscrupulous shikaris and villagers. The powers given to the Local Governments under the Act include powers to prevent such killing, but the Rules so far framed in some of the Provinces at least, do not deal with the question at all. There does exist under those Rules a general prohibition with regard to female and immature animals, but protection at any time or place, water-holes included, to mature male animals is entirely absent.

The practice of killing over water is admittedly pernicious, and is not of a local application but applies to all the Provinces alike. In this view, therefore, it would seem that this was an apt

subject to be embodied in the enactment to constitute an offence by itself.

10. Again, under Section 8, it is permissible to capture or kill any wild bird or animal in *bona fide* defence of property. In other words, everything sought to be protected by the law may be captured or killed if found doing damage, say to field crops, the property usually affected. How far such capturing or killing is *bona fide* or gives a scope to the professional killer for the sake of flesh and skins is difficult to determine, but not a little slaughter of animals may always be expected under the latitude given by this Section, under the simple excuse of crop protection.

It is recognized that the question is a knotty one to deal with, but deliberations on the subject may bring forth a solution.

11. Lastly, it would seem to have a temperating effect on the indiscriminate killer if, on the lines of some of the other laws, *e.g.*, Section 54 of the Indian Forest Act, the trying Magistrate's power of confiscation as defined in Section 5, is also extended, in extreme cases, to the articles used in committing the offence.

In some Provinces, *e.g.* the Central Provinces, the Indian Arms Act may be requisitioned to assist the Wild Birds and Animals Protection Act, and offenders may, thereunder, be deprived of their guns. But those are not the only articles used in committing an offence, as snares, traps, axes, carts and sundry other articles may also be used.

NAZIR ABBAS,
Extra Assistant Conservator of Forests.

CHANDA, C. P.
16th May 1927.

HOW A TREE GROWS.

BY WILLIAM SOMERVILLE, (Oxford University Press and Constable & Co., Bombay & Calcutta, Price 10s.)

This small volume is somewhat comprehensive in its scope as it deals not only with the general morphology of trees but also with the character and identification of timbers; ending with a *summary of the characters of the European Hardwood timbers* and the characteristics of the timbers of the different genera of the Coniferæ.

Its use in India is limited by the fact that the references and illustrations in the book belong to European species or to conifers of temperate climates cultivated in Britain

The book, as its name explains, sets out to explain the phenomenon of growth in trees, a subject in which many laymen take an interest but about which there is a good deal of ignorance. Starting with a description of the cell, the author explains how growth in height and lignification is brought about. Considerable space is devoted to the structure of terminal and axillary buds. Next comes the study of the microscopic structure of wood in general and a description of the various kinds of vessels composing the wood of broad leaved trees and conifers; the difference in spring and autumn wood and the relationship of ring breadth to quality. The section dealing with the identification of timbers belongs more to the subject of wood technology than to a book dealing with the growth of trees. The volume is well got up and the illustrations numerous and good and we can recommend the book to those interested in trees, as it offers considerable information in a small space.

REPORT ON THE PROGRESS AND PROPOSED FUTURE EXPANSION IN THE UTILIZATION OF THE FOREST RESOURCES OF MADRAS.

By J. Kenneth Pearce

The report under review was drawn up with the intention of giving a general idea of the timber resources of the Madras Presidency, the extent to which they are now being utilized, the areas

in which they are most readily accessible, the quantity and species of timber which can be exploited and the markets available.

In the opening chapter the general situation throughout the world as regards timber supplies has been reviewed and it is shown that before long the world will have to look to the tropics for supplies of soft woods, which are rapidly diminishing. The Philippine Islands, the Federated Malay States, and the Dutch East Indies have already taken steps to exploit their timber resources, by up to date methods, and the writer shows how necessary it is that Madras should follow their lead.

There are 19,012 square miles of forest in the Madras Presidency of which 14,854 square miles are of sufficient value or importance to be permanently retained under the control of the Forest department, and 557,553 acres have been declared to be "commercial" forests carrying a stand of not less than 350 c. ft. to the acre of timber over 3½ft. girth, fit for exploitation. The critesion, 350 cubic feet to the acre, seems to be a low one and it does not look from these figures, as though the Madras forests were of great value. It is to be hoped, therefore, that it is but a small portion of this 5½ lakhs of acres that carry the minimum stand. At present only 1,230 acres of these commercial forests are clear felled annually, while 3,577 acres are worked over by selection felling

The total amount of timber extracted from reserved forests during 1924-25 was 47,860 tons, of which the commercial forests only yielded 18,386 tons or 38 per cent., while timber to the average value of Rs. 98,71,068 was imported. It is a striking fact that the total amount of timber extracted from commercial forests was only 18,004 tons or 30·5 per cent. of total of 59,218 tons imported while the total timber extracted from commercial and non-commercial forests was still 30 per cent. smaller than the average quantity imported.

It is thus apparent that there is a large demand for timber which is not met from the forests of Madras and the writer proceeds to review the demands of the principal consumers and shows that these are likely to increase in the future.

There then follows an interesting account of the activities of the Forest Engineering Branch and what is has accomplished since

its inception, in 1923. Up to date mechanical methods of extraction have been introduced in the case of the exploitation operations in Chenat Nair, resulting in an increased output and a large drop in the cost of extraction. Many of the evergreen timbers extracted from this area are not known on the market and in order to get these timbers known and appreciated it was decided to instal a sawmill and seasoning kilns at Olavakote so as to be able to supply consumers with sawn and fully seasoned timber. Owing to delays in the arrival of the machinery the mill was not erected till the end of 1925 while owing to the late arrival of the machinery and to other unavoidable delays, many of the logs, composed of soft wooded species, had been laying in the depôt and had deteriorated badly before they could be milled, so that there was much wastage in conversion.

As the writer points out, the Chenat Nair Exploitation division was established as a commercial experiment to log, convert and market evergreen species, very few of which are at present known on the market, and he proceeds to give an account of how it has been possible to create a market for timbers which were previously considered to be valueless. This enterprise is worked on a commercial basis but up to date has not shown a profit, largely due to the reasons given above; but it is hoped that, as increasing markets are found for the new timbers, the position will be reversed and the undertaking will show gradually improving financial returns at the same time serving to increase the potential value of the evergreen forests, by creating a demand for those species now considered to be valueless.

One of the most important innovations made by the Forest Engineering Branch has been the introduction of portable sawmills. The first of these was introduced at Beypore to cut up the large surplus stocks of logs which had accumulated in the depôt owing to selected logs only having been purchased at the auctions. That this undertaking was justified, can be gauged by the fact that the mill made a profit of Rs. 39,425 during the first 10 months of its operation and actually paid for itself in 3½ months! In addition it has a beneficial effect which is not apparent from these figures in that the profits of the log depôt were increased,

as the merchants realised that, if fair prices were not offered, the logs would be taken for conversion in the mill. Three other such portable sawmills have been installed to saw up and supply sleepers to the railways, while at the same time the sawing of special orders for the railways and Government departments is becoming an increasingly important function of these portable sawmills. The sound policy of selling better quality logs, which pay a profit, in log form, and of sawing surplus and inferior logs in the mill is being followed. These mills had been installed quite recently, at the time of writing the report, so that it was not possible to give any account of their financial positions. If however, they prove to be as successful as the mill installed at Beypore, it is an enterprise which other Provinces might do well to copy.

Another important development of the Forest Engineering Branch has been the introduction of "cruising," or the enumeration of a stand of timber, giving the amount of each species by small units of area and an accurate large scale map of the areas in which the cruise is made. With this data the best logging methods can be determined, transport routes laid out, and costly mistakes anticipated and avoided. Not only has the Chenat Nair area been "cruised" but also many other areas in which working has not yet been started.

In the earlier parts of the report it was shown that there is a very large demand for timber in Madras and that the forests are not being worked to their fullest extent and that expansion can take place without exceeding the annual yield. Further expansion would also tend to reduce the production costs by reducing the overheads per unit and the manner in which this expansion can take place is described and a programme for the next 5 years is mapped out.

If the existing schemes now in hand prove to be as remunerative as expected there is no reason to doubt but that the Legislature will provide the department with the funds necessary for the expansion outlined, as the revenue should be increased in proportion, as well as money kept in the Presidency, which is at present expended outside, on purchase of timber.

In the appendix is given a note on the Veneer Industry and its relation to the profitable utilization of South Indian Hardwoods by Mr. J. W. K. Wernham, the *Forest Utilization Officer*. In this note he gives an account of the manufacture of veneers in America and outlines the methods by which this practice might be applied in India to aid in the economic development of its hardwood resources. There is also a note on a tour in the Philippine Islands by the writer, Mr. J. Kenneth Pearce, to show the manner in which modern methods of mechanical exploitation can be applied to tropical forests.

The whole report is interesting giving the reader, as it does, an insight into the forest resources of the Madras Presidency and showing the scope that there is for expansion and the steps that are being taken to bring this about.

The intention to progress and the optimism shown in this report would appear to indicate that the Engineering Branch of the Department is living up to the motto of the Forest Service *Meliora speramus.*

F. D. A.

EXTRACTS.

STATE FORESTRY.

WORK OF THE COMMISSION.

In a Press statement on the work of the Forestry Commission during the past session of Parliament, Lord Clinton, the chairman said yesterday that under the programme prepared in accordance with the Forestry Act of 1919 close upon 100,000 acres had been planted with timber. Last year the Commission planted between 22,000 and 23,000 acres, which represented one of the biggest planting programmes ever carried out in any English-speaking country.

The Forestry Act of 1919 made financial provision for the ten-year period ending March 31, 1929, and it was expected that by that date the Commissioners would have planted 139,000 acres. Another 100,000 acres would probably have been planted by

municipal and private owners—75,000 acres of this with State assistance—making the total acreage planted 239,000. A general survey and census of existing woodlands completed during the past year brought out only too clearly the need for an extended programme of State forestry. Of the 3,000,000 acres of land described as woodland before the war, little more than half could be said to be economic. To-day there were 62 forests in England and Wales and 50 in Scotland, and the number was increasing by something like 15 new forestry centres each year. These new centres were, of course, in addition to the developments carried on in connexion with the old ones.

It was satisfactory to note the figures relating to the employment provided by the Commission's forests, said Lord Clinton. For example, in the summer of 1920 the minimum number employed was 210; in 1926 it was 2,335. In the winter of 1920-21 the maximum number was 935; in 1926-27 it was 3,185. In this respect, it had been particularly pleasing that in East Anglia, which was hard hit by depression in the agricultural industry, the Commission was able to give useful employment to a number of labourers. The extent to which afforestation could be economically employed in relief of temporary unemployment was strictly limited. On the other hand, the policy of establishing forest workers in small permanent holdings in or close to the forest had much to commend it, giving a man, as it did, assured work in the forest and also the opportunity of improving his position by his own independent efforts on his holding. Each year—mainly in the winter months—150 days' employment was guaranteed, leaving the worker free to work his land in the summer and to take advantage of other employment available during the hay and corn harvest. The maximum size of these holdings was ten acres. The smaller holdings are the more popular, and on these market gardening and poultry and pig farming were carried on. In the larger holdings accommodation was given for one or two cows, and the holder frequently conducted a small dairying business. A system of co-operative marketing had been established which gave good promise of success. The systematic formation of these forest workers' holdings was begun in

1924, and it was estimated that 750 would be completed or in process of establishment by March, 1929.

Special attention was being paid to the education of forest officers and foresters, and to research work affecting the many silvicultural problems. This research and experimental work had indicated the solution of some important questions. A case in point was the planting of molinia peats, which covered an extensive area in the North of England and Scotland and if the experiments were successful a very large area of land, of the lowest present value, would become available for planting—[*Times, 9th August 1927.*]

EMPIRE FORESTRY ASSOCIATION.

ANNUAL REPORT, 1926.

The Governing Council in presenting the Statement of Expenditure and Balance Sheet for the year 1926, desire to say that for the first time since the formation of the Society, all Life Membership Subscriptions have been credited to a special account, one fifteenth only of such subscriptions having been credited to income for the current year.

Members will note with pleasure that there is an increase in annual subscriptions of approximately £100, and that expenditure has been very considerably reduced. The whole of the expenditure in connection with the granting of the Royal Charter has been written off; 25 per cent. has been written off the value of the furniture, and there is considerable reduction on the item of rent due to the removal of the offices to 22, Grosvenor Gardens.

It is anticipated that during 1927 the total expenditure will not exceed £900, and it is hoped that before the end of the year sufficient new members may be enrolled to render the Association self-supporting.

Membership in the Association is steadily increasing. During 1926, 109 new members were enrolled, 6 transferred from professional to full membership, while 11 transferred from full to either associate or professional membership. Resignations and deaths totalled 16, showing a net increase for the year of 93. Total membership of all classes now amounts to 658, made up as

follows: Life, 188; Associate, 34; Professional, 389; Affiliated 47. During the year H. M. Government of Ceylon has become a life affiliated member. In future life affiliation fees will be put on the same basis as those received from life members.

During the past year the most important events in the forestry world have been the holding of the World's Forestry Congress in Rome, which was attended by the Chairman, Sir John Stirling-Maxwell and Mr. Fraser Story, the Editor of the Journal; and the prominence given to forestry at the Imperia Conference—evidence of increased interest in the subject and the awakening of an Empire forest conscience. Condensed reports of these conferences have appeared in "Empire Forestry."

It is with great pleasure that the Governing Council are able to report that a special Committee will shortly be appointed by the Empire Marketing Board to consider the best means of improving conditions under which Empire timbers are marketed.

Another matter of importance is the establishment of a Committee nominated by the British Engineering Standards Association for the purpose of standardising tests of timber throughout the world.

The Standing Committee on Empire Forestry, in which the Association has taken considerable interest, is now an accomplished fact, and reports will be forthcoming at the Annual Meeting of the work achieved.

The increasing circulation of "Empire Forestry Journal," the letters of appreciation received from members, and the favourable comments of the Press and general public form evidence of the careful work undertaken by the Honorary Editor, Mr. Fraser Story. The thanks of the Association are due to all those who so ungrudgingly supply reports, articles and reviews, without whose co-operation the publication of the Journal would be impossible.

Mr. G. A. Wilmot, Consulting Forester to the Lion Match Co., who has rendered such valuable services as Honorary Local Secretary of the E. F. A. in South Africa, and whose efforts have resulted in a large increase in membership, has, owing to frequent absence from Durban, asked to be relieved of his responsibilities.

Mr. H. A. Read, of the Exchange Yard Limited, Johannesburg, has consented to fill the vacancy.

Under Section III of the By-laws, the Governing Council have filled vacancies on the Council during the year, as follows :—

Sir Peter Clutterbuck, C.I.E., C.B.E.
Mr. S. A. Courtauld.
Mr. James Richardson.
Mr. Ellwood Wilson.

The following members of the Council retire under the By-laws, and being eligible, offer themselves for re-election :—

The Rt. Hon. the Duke of Devonshire, K.G., G.C.M.G.
The Rt. Hon. Viscount Novar, K.T., G.C.M.G.
Sir John Stirling-Maxwell, Bt.
Sir Hugh Shaw Stewart, Bt., C.B.
Colonel Sir George Courthope, Bt., M.C., M.P.
Hugh Morrison, Esq., M.P.
Colonel S. S. Mallinson, D.S.O., M.C.
Major T. F. Chipp, M.C., Ph.D., F.L.S.
Sir Alfred Ashbolt, Kt.
W. S. Millard, Esq.

JOHN STIRLING-MAXWELL,
Chairman, Governing Council.

MY MOST INTERESTING DAY IN THE FORESTS.

(WINNING ESSAY FOR THE "INDIAN FORESTER" PRIZE FOR 'PRESENT' STUDENTS, 1927.—BY P. G. RAO, SENIOR STUDENT.)

The day that interested me most in the walk of forest life dates back to the year 1921, when the Non-cooperation movement was in its full swing in the Guntur District. The common folk in the forest villages, having received concentrated intra-veinous injections with effective ampules of seditious preaching delivered openly by the so-called propagandists of the movement, took up their banner against the forest subordinates. Day by day, the people became more and more ill-spirited, and the matters assumed

a stage, when no Forester or Forest Guard, owing to the social boycott of the forest villagers at every step, could either live in the villages or do their legitimate duties in the forests. The forests were looted by the bands of villagers in head loads, ass loads, and cart-loads and the charity of the stolen property extented from father-in-law to son-in-law and his friends, and friends to their friends in distant villages. All the closed areas under regeneration were strictly closed with herds of cattle penned inside.

The then Range Officer of the Vinukonda Range, having well studied the situation, summoned all the subordinates of the Range and organised them into a strong party headed by me, the Forester. The party then made a move with full camp equipment to a central village in the Range with the Range Officer.

We had information that about a thousand cows were kept penned in a closed area of the forest guarded by about seventy villagers. The Range Officer having come to know of this issued orders to me late in the evening to go to the spot immediately with my party, and see that at least some of the cattle are impounded and some of the men brought before him for necessary action.

Next day early morning, at about 4 A.M. I set out to the forest with a strong party of four Foresters and twenty-two Forest Guards, in all twenty-six in number. Before day-break we reached the spot in a forest where we could safely lie in ambush watching the movements of the cows and the villagers.

The cattle left the pen at about 7 A.M. for grazing, followed by the sturdy grazier-men who by their sheer force and strength could easily overpower us. Many of the graziers happened to be men of influence and wealth and criminal force was all for them to defend their position in those days.

I had my own strategems pre-planned to meet effectively with the situation. I found no way out but to tackle the graziers with tact and I dressed myself in Khaddar (country made cloth) to pass before them for a Non-cooperator of the day. My action was purely actuated by good motives and as such, *bonafide*, I had my defence under section 61 of the Madras Forest Act.

With the dress thus changed I equipped myself with all the necessaries to make an ideal detective.

The sun was rising up and it just passed the meridian. It should be about 1 P.M. It was usual for the cattle to go to a tank near by to drink water, and was the time for the graziers to take rest for an hour or two after taking in their midday *khana* (meals). By noon I split up my party into two batches and one batch of the two Foresters and eight Guards under the leadership of the Foresters was instructed to proceed to the tank concerned, unnoticed by the graziers, waiting for an opportunity to drive as many cattle as possible to the pound

The other batch I was to lead to create an easy opportunity for others to carry out my proposals successfully. I walked towards the cattle paths leading to the tank from inside the forest with my followers. The cattle were seen coming down for water followed by the villagers and it was time for me to act, I should so manage as to be their object of attraction and I was sure that a lecture on a subject very pleasing to them, would serve the purpose. The subject chosen by me was one of interest to the forest villagers at the time. With a small audience of my own followers I started my lecture condemning the illegal actions of the lower forest subordinates and the resulting worry caused to the people at large. I laid stress on the good-will and co-operation of forest villagers for the proper and useful working of the forests. I found an appreciable increase in my audience, in a short time, by the addition of the graziers following the cattle. I felt that I had gained some ground in my attempt and elaborated my lecture in a way most pleasing to my new audience. I explained to them the facts that the real interests of the Government in the management of the forests have been based solely on the welfare of the present and future generations of the people, mostly in the forest villages, and how the beautiful forests of the old had been indiscriminately destroyed resulting in the necessity of their being reserved, protected and improved at the present day. I spoke at length about their very industry, agriculture and its relationship with the conser-

vancy of forest to feed springs, rivers, and channels, and emphatically declared the benefits derived therefrom to be enjoyed by them directly or indirectly. I pointed out the object of the Forest Department was to teach and educate the people to manage the state forests in the interests of the public at large by self-constituted bodies for the benefit of their own kith and kin, as exemplified in the introduction of the Panchayat and the Village forest systems of the day. I had convinced them of the fact that their co-operation with the Government was absolutely necessary in their own interests but I studiously avoided talking anything of their illicit grazing for the time being.

They became more and more interested in my lecture and followed me about a mile away from the tank, but alas! poor villagers not knowing that they have left behind their cattle which were being driven away to the pound by my other batch. I had been lecturing for about an hour and I found the villagers to be good and willing audience.

Suddenly, we saw a grazier-boy running to us with the information that he had seen from the top of a hillock some cows being driven away to the village side by some people whom he could not identify from a distance. The graziers, in front of me, on hearing the news were quite perturbed and were at a loss to know how it happened and who the drivers were. They questioned my batch whether any of their men had gone patrolling elsewhere in the forest and the reply was cleverly in the negative. They were cocksure that no forest subordinates could dare drive their cows in those days and to add to it my party stood seemingly unmoved by the news.

Now I was glad within myself that a portion of my plan was successful and I had to accomplish the further plan of bringing the offenders to book. We found later on that only about twenty per cent. of the cows in the forest, that is to say, about two hundred in number were found missing from the group.

All the graziers, in a voice, requested me to accompany them to rescue the cows, but they half suspected my batch who also now traced their steps back in the direction of the cows driven

by the other batch. In fact my dress then saved the situation. At first, I showed no inclination to follow them pretending I was bound elsewhere till they pressed me on and on to be with them when I consented at last to follow them and in fact, this was what I wanted then.

We walked off towards the village in a hurry but I lagged behind on approaching the outskirts of the village fields, on the plea that I was a poor walker. The graziers ran to the village following the traces of the cows leaving me behind to join them soon but I took my own way unnoticed by them, got into the village and appeared in full uniform before them near the pound.

In the village I found what I had expected. Before the pound,—the ring leaders numbering about twenty-five, the Range Officer with some of his subordinates, the village munsif with his village police and the two beat police constables all numbering about fifty on the Government side were found The cows were impounded and the offenders were arrested when they refused to give their names and they were handed over to the police.

The prosecution was launched and the case was disposed of within a week by the special touring Forest Magistrate. The judgment was pronounced and an exemplary punishment was meted out to the accused.

This case which was successfully detected by my party proved to be a turning point in the affair of the neighbouring forest villages. The villagers were brought to their senses and they learnt at a great cost that peaceful submission and obedience to the Forest Laws would ensure their happiness and prosperity in the long run. To conclude, peace and order were restored in the villages affected by the Non-cooperation movement.

'TACT.'

[The Editor has no responsibility for the composition of this article.] (*Madras Forest College Magazine, June* 1927.)

THE ERADICATION OF KANS ("SACCHARUM SPONTANEUM" L.).*

By ALBERT HOWARD, C.I.E., M.A., *Director, Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India.*

One of the chief obstacles to the growth of cotton and other crops in Central India, Bundelkhand and parts of the Central Provinces is a perennial deep-rooted grass known as *kans* (*Saccharum spontaneum* L.). At a conservative estimate the reduction in the yield of cotton caused by this weed is at least a third of the crop. The implements at the disposal of the cultivator only serve to keep *kans* in check, they do not eradicate it. Attempts are now being made in some parts of India to bring this pest under control by means of tractors but the method is expensive and not very suitable for the ordinary villager.

As more than half the three hundred acres leased to the Institute of Plant Industry were infested with *kans* and quite unfit for experimental work, the eradication of this weed was at once taken up. The funds available were insufficent either to consider the purchase of a tractor or to adopt the local method of digging out the weed by hand which costs about eighty rupees an acre. Some cheaper method therefore had to be devised.

The first attempts were made with heavy soil-inverting ploughs—Ransomes' steel-bar plough and the C. T. plough were tried, each drawn by two pairs of oxen in the usual manner. The results were unsatisfactory and the amount of work done each day was small. The failure of these ploughs was partly due to the great force needed to turn a deep furrow, and partly to the fact that when two separate pairs of oxen are yoked to the same plough there is a good deal of non-cooperation and the animals only occasionally pull together. A little consideration of the problem soon led to the conclusion that furrow-inversion—so es-

*Paper read before the Agricultural Section of the Indian Science Congress, Lahore, January 1927.

sential in the damp soils of the Occident for killing weeds by cutting off the light—is quite unnecessary in India where the sun does the same work for nothing once the weeds are loosened or uprooted. Soil-inversion, besides requiring a large amount of draught, interferes with levels and is particularly harmful on black soils after the rains by producing large clods which prevent the work cattle from walking on the cultivated surface.

These difficulties were overcome by the use of an adjustable *bakhar* capable of working to a depth of eight to nine inches drawn by two pairs of oxen *walking abreast*. This *bakhar* was obtained by dismantling and slightly altering the P & O. 10 inch ridging plough manufactured by the International Harvester Company and on sale in India at forty rupees. The broad share of this plough, when the wings and sole are removed, acts as a very efficient and self-cleaning *bakhar* blade and uproots the dense mass of *kans* rhizomes which run mostly in the upper eight inches of soil. The depth of working is adjusted by the front wheel. The yoke is attached to the sub-soiler by a strong chain of suitable length, so arranged that the line of draught passes through the centre of resistance of the share. The draught is supplied by four oxen walking abreast provided with a long yoke 9′-4″ long by 1′-7″ deep fitted with iron pins which prevent the oxen getting off the yoke when turning Under this system non-cooperation disappears, the animals work together and exert their maximum power. One of these sub-soilers will plough an acre of land a day at a cost somewhat below five rupees. This adjustable *bakhar* is proving very effective in *kans* eradication at Indore and this adverse factor is rapidly being eliminated. Plots infected with *kans* in September 1925 were fit for cotton cultures by June 1926. The most effective periods for dealing with this pest appear to be during the time of active growth in the rains or at the beginning of the cold weather, but this and many other matters relating to this weed need further investigation.

The adjustable *bakhar* drawn by four bullocks walking abreast is all that is required for the occasional deep cultivation of

black cotton and other Indian soils. More expensive machinery does not appear to be necessary, and in future any well-to-do cultivator can obtain for the trifling sum of forty rupees all the benefits of a tractor or steam plough without any of the disadvantages of these costly and uncertain machines. The deep cultivation involved in the eradication of *kans* produces other useful results. The land becomes remarkably free from weeds and the cotton crop is considerably benefited. The complete ridging plough is also proving useful at Indore in growing cotton on flat beds separated by furrows. The additional surface drainage so provided is followed by better root-development and by increased growth.

This method of eradicating *kans* and other deep rooted grasses was demonstrated at the recent Agricultural Exhibition held at Poona in October 1926. It attracted wide attention and a large number of orders for the new yokes and for the complete outfit were received. Yokes are supplied for Rs. 11 f.o.r. Indore, iron parts of the yokes are sold for Rs. 3 while the complete outfit, consisting of yoke, chain and the converted ridger, costs Rs. 62 f.o.r. Indore.—[*Agricultural Journal of India, January 1927.*]

WORLD'S LIGHTEST WOOD.

Efforts are being made by London timber importers to find a wider commercial use in this country for Balsa wood, a timber grown in the swamps of British Honduras, which weighing only half as much as cork, is the lightest wood in the world.

Although closely resembling deal in colour, Balsa wood has so soft a texture that for years it was considered commercially useless, but it has been found that cemented between thin sheets of plywood it can withstand hard wear.

During the war its exceptional buoyancy led to its use for floating mine nets and emergency rafts for liners. More recently experts have discovered that Balsa wood has insulating qualities which make it fitted for lining telephone boxes, refrigerating chambers and the walls of houses.—[*Timber News, 28th January 1927.*]

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THE NATIONAL AND IMPERIAL IMPORTANCE OF THE BAMBOO PULP INDUSTRY.

Considerable interest in bamboo as a paper making material has recently been aroused in business and technical circles in England as a result of lectures delivered by Mr. W. Raitt, Officer-in-Charge, Paper Pulp Section, Forest Research Institute, Dehra Dun, before the Technical Section of the Paper Makers' Association of Great Britain and Ireland and the Forestry Section of the British Association, Leeds. It is a far cry from the early seventies of the last century when Mr. Thomas Routledge brought bamboo into prominence as a primary source of raw material for the paper industry. Chemical wood pulp had just then emerged from the experimental stage and the technique of its manufacture was rapidly developed on the Continent. England could then get plentiful supplies of wood pulp from Sweden and Germany, and the interest in the bamboo question was allowed to recede into oblivion.

The Government of India, however, foresaw the great potentialities of bamboo and did not relax their interest in the subject. In 1905, they invited Mr. R. W. Sindall, a paper pulp expert to enquire into the possibilities of paper pulp manufacture in Burma. Mr. Sindall's able and comprehensive investigations-

however, did not result in any commercial undertaking. The irreducibility of nodes and the selection of culms for age proved a serious handicap for the exploitation of the material. Moreover, a number of trials, undertaken on a commercial scale by paper makers, gave conflicting results as regards yield and quality of cellulose from the various species of bamboos and the cost of bleaching was found to be prohibitive

About this time, Mr. Raitt engaged himself in the investigation of the technical aspect of bamboo pulp manufacture. In 1908, Mr. R. S. Pearson, Forest Economist at the Research Institute, undertook surveys of the principal bamboo areas in Burma and Western India Mr. Pearson compiled a wealth of information regarding the predominant species of bamboos, their habits and growth, yield per acre, suitable rotation for cutting, cost of transport, etc., and he also dealt at length with the economics of manufacture at a few suitable sites. Mr. Raitt's researches based on the fractional method of digestion, which he evolved during the course of his investigations, found a solution for most of the difficulties which had till then stood in the way of economical conversion of bamboo into pulp. He found that it was not necessary to reject the nodes, that all the predominant species (except *Melocanna*) and culms of different ages could be indiscriminately mixed for chemical treatment and that uniformity as regards yield and quality of pulp could be attained by adopting the fractional system of digestion combined with the sulphate of soda method.

The laboratory experiments, however, were not calculated to inspire confidence in business circles and Government felt justified in installing in 1923 a large-sized experimental plant at the Research Institute to carry out the tests on a semi-commercial scale. The investigations during the last four years at the experimental plant have not only confirmed the previous laboratory results but have brought about considerable improvements in the technique of pulp manufacture and a consequent reduction in the cost of production. The position as regards the main items in the cost of manufacture, now arrived at, as

compared with that of 25 years ago is summarised below :—

	Then.	*Now.*
1. Selection for age of culms	Necessary.	Unnecessary
2. Nodes	Unusable.	Usable.
3. Caustic soda used on bamboo.	24%	16%
4. Bleach used on unbleached pulp.	22%	8%
5. Steaming time ...	10 hours.	5 hours.
6. Average steaming pressure	80 lbs.	30 lbs.
7. Yield of unbleached pulp .	37%	45%
8. Yield of bleached pulp ...	32%	42%

Further it has been demonstrated that bamboo fibre is eminently suitable for all classes of papers from brown kraft to high class printings and writings. Laboratory experiments, in progress at the Institute, also indicate that bamboo pulp is equally suitable for artificial silk and that its industrial applications can be as varied and extensive as those of wood pulp. Conservative estimates of the cost of production based on factory experiments at the experimental plant show that it is possible to manufacture bamboo pulp on a large scale at a lower cost than that of pulp from other raw materials available in the country; also that it is possible to deliver unbleached pulp at British ports at £2—£3 per ton less than the corresponding imported wood pulp from Sweden and other countries.

The long and arduous investigations carried out at the Institute have at last established, both from technical and commercial points of view, the position of bamboo as a material *par excellence* for paper and other cellulose industries. It rests now with the enterprising capitalists to translate these results into commercial ventures. Extensive bamboo forests, running into thousands of square miles and capable of yielding several million tons of pulp per annum, are awaiting exploitation in India and Burma.

The utilisation of these vast resources is important both from national and imperial standpoints. The Government of

India have spent, up to date, about five lakhs of rupees on the investigations. They have pledged themselves to the encouragement and protection of the industry and the local Governments concerned are prepared to lease out bamboo forests on liberal and generous terms.

The total consumption of paper in India is approximately 100,000 tons per annum. Of this only about one-third is produced in the country, and that too, with the aid of about 12,000 tons of wood pulp imported annually from foreign countries. The supply of *sabai* grass (*Ischaemum angustifolium*), which has hitherto been the staple material of the paper maker in this country, is already inadequate to meet the demand. It has been conclusively established by the investigations of the Tariff Board that bamboo pulp alone promises not only to provide for the present needs but also for the future expansion of the industry, which is inevitable, considering the growth of literacy and democracy in the country. The establishment of the Bamboo Pulp Industry will, it need hardly be said, not only serve to make the country self-contained in respect of an industry of primary importance in modern life but will also help to contribute towards the economic development of the country and the partial solution of the unemployment problem which is becoming more acute every day. It will further serve an imperial end by providing for England and other parts of the Empire (except Canada which has vast resources of her own in wood pulp) adequate supplies of material for industries of vital importance in national economy. England alone imports over half a million tons of chemical wood pulp, and over 300,000 tons of Esparto grass from outside the Empire, for her paper industry. With the expansion of the new cellulosic industries, which scientific progress has given birth to in recent years, *e.g.*, artificial silk, explosives, celluloid and films, lacquers and varnishes, paper textiles and utensils, etc., the demand for cellulose is bound to develop enormously in the near future.

Nearly the whole of the world's supply of pulp for paper and cellulose industries is derived from coniferous wood and is in the neighbourhood of 15 million tons a year, representing

roughly 40 million tons of raw wood; and the normal expansion of paper consumption is estimated to be about 25 per cent. in 10 years. The colossal drain on the timber resources of the world, by the saw-mill, paper and the cellulose industries, has resulted in the exhaustion of the accessible and economically exploitable areas. Those who are in a position to speak with authority on the subject predict, in unequivocal terms, an impending serious shortage of pulp wood for paper and cellulose industries. As mentioned before, bamboo pulp can be put on the market at competitive prices and supplies of the material in this country are available for exploitation *in perpetuum*. Bamboo is annually reproductive and, therefore, there is no risk of the depletion of the economically exploitable areas at any time.

Therefore, as a purely business proposition and as a matter of imperial concern, there is, *a priori*, a strong argument for the British paper maker to substitute a major portion of the imported paper making material by bamboo pulp produced within the Empire. Efforts are being made to make the Empire self-contained in respect of wheat, cotton and other essential commodities. Why should not the Empire be self-sufficient as regards supplies of materials for the important paper and cellulose industries? Mr. Raitt has done a service to the country and to the industry by drawing the attention of the British public to the subject. It is in the fitness of things that business men in this country should hasten to take interest in the question and lead the way for the establishment of an industry which bids fair to grow enormously in future.

THE HIMALAYAN SILVER FIRS AND SPRUCES.

It will probably save confusion to start this note by saying that I shall refer to the Himalayan silver firs as :—

1. The High Level Silver Fir (*Pinus* or *Abies spectabilis*, or *Abies Webbiana.*)
2. The Low Level Silver Fir (*Pinus* or *Abies pindrow.*)
3. The Sikkim Silver Fir (*Abies densa.*)

The first two are trees of the Western Himalaya and the third of the Eastern Himalaya. In quoting the various works of Lambert on the Genus Pinus I shall quote the date instead of the edition and in the edition of 1832 I shall omit the number of the volumes. By quoting the date instead of the edition there can be no mistake or doubt as to the work whereas in the Index Kewensis and elsewhere the references are wrongly quoted In the 1832 edition the work is bound up in two volumes with the pages and plates numbered serially so that there is no advantage in quoting the volume. Judging by some of the references to this edition the work has not always been divided into volumes in the same way and some copies seem to have been issued in three volumes instead of two so that confusion results if in the reference no mention has been made of the date and the edition is wrongly quoted.

A curious confusion has arisen over these silver firs due in the first instance to a misconception as to what Lambert intended to describe as *Pinus spectabilis* and secondly by almost every authority who has split up the Himalayan silver firs into two species making the division into a High Level and Low Level species instead of into an eastern and western species. The result of this is that the most recent name proposed for the High Level silver fir, *viz.*, *Abies spectabilis*, Spach, var. *brevifolia*, Rehder in Journ. Arn. Arb. I (1919) p. 54 falls to the ground since as I propose to show *Pinus spectabilis*, Lamb. is intended to be the High Level silver fir and hence the High Level silver fir cannot be treated as a variety when it is the type of the species.

The High Level silver fir should strictly speaking be called *Abies spectabilis*, Spach Hist. Vég. XI (1842) p. 422. The combination is based on *Pinus spectabilis*, Lamb. Gen. Pin. II (1824) p. 3, t. 2. With *Pinus spectabilis*, the history of the Himalayan silver firs begins. Lambert gives the distribution as "Gossain Than and elsewhere in the Himalaya, *W. S. Webb.*" He states that the species was discovered by Capt. Webb and that the specimens on which his plate is based came from Wallich. He quotes as synonyms *P. tinctoria et Webbiana, Walleck in literis.*

The plate appears to be mixed, figures B (there are three all showing male catkins) belong I believe to *Abies densa*, Griff.

Lambert apparently discovered that the specimens were mixed as in his Gen Pin. (1832) p. 77, t. 44 he publishes *Pinus Webbiana*, Lamb. His plate is still called *Pinus spectabilis*, the change of name being made only in the text. The plate is clearly based on and partly copied from his earlier work but he omits all the B figures and in the text omits the synonym *P. tinctoria*, Wallich but quotes *P. Webbiana, Wallich in litt.* In order to make the lettering in his two plates agree he labels the figure of the cone bearing shoot (which has been redrawn) AB and keeps the others as before (except that by accident one figure of the anthers is labelled F, instead of both having been called E).

From the above I think we are justified in concluding that Wallich thought there were two silver firs which he calls *Pinus tinctoria* and *P. Webbiana*. That the Gossain Than specimens which were collected by Wallich himself were *P. tinctoria* and that Webb's specimens from "elsewhere in the Himalaya" were Wallich's *P. Webbiana* and except as regards the male catkins *P. spectabilis*, Lambert. I am inclined to think that Lambert was doubtful about Wallich's plant being different to Webb's but thought it safer to omit the former and base his plate 44 of 1832 on Webb's specimens only. This, however, is somewhat speculative, what is certain is that Lambert was trying to describe Webb's fir and that *Pinus spectabilis*, Lambert is mainly Webb's plant.

According to Major Madden, "*Observations on Himalayan Conifers*" in Journ. Agri-Hort. Soc. Ind. VII (1850) p. 75, Webb found his fir in S.-E. Garhwal on one of the spurs of Trisul. According to Royle, Ill. Bot. Himal. (1839) p. 350, Webb found his fir in the Bhotea parganas of Kumaon which may mean Garhwal since in Royle's time Garhwal was not treated as a separate locality in Kumaon Webb is believed to have found his fir near Ramnee between the Pindur and Alaknanda rivers and it might be thought curious that he should

have come across the High Level fir rather than the Low Level fir. The Low Level fir is, however, so often missing in places where one would expect to find it that it would not be difficult to select a route by which a collector would come upon the High Level fir without first coming across the Low Level fir. Moreover Lambert in Gen. Pin. III (1837) t. 92 under *Pinus pindrow*, states that the Low Level fir was observed by Webb in Kumaon but not found by him in flower or fruit.

The Low Level silver fir if treated as a species, should be called *Abies pindrow*, Spach, Hist. Vég. XI (1842) p. 423. Regarding this tree there is fortunately no doubt. The first description of the plant is *Pinus pindrow*, Lamb. Gen. Pin. III (1837) t. 92. Lambert l. c. and also Loudon (*Picea Pindrow*, Loudon, Arb. et. Fruct. Brit. IV (1838) p. 2346) quote *Pinus pindrow*, Royle, Ill. Bot. Himal. t. 86. Royle's work appeared in parts spread over many years, pp. 1—40 appeared in 1833 but p. 354 which contains the description of *Pinus pindrow* Royle did not appear till 1839. The plate 86 was clearly available long before the text referring to it and consequently could be quoted by Lambert and Loudon though their works bear a date earlier than Royle's.

The Sikkim silver fir is *Abies densa*, Griff Itin. Notes (1848) p. 141, No. 662 (diagnosis); Journ. (1847) p. 246 (nomen). Elwes and Henry Trees of Gt. Brit. and Ire. IV p. 752, do not recognise this species and Elwes states that Griffith abandoned his name and adopted that of *Abies Webbiana*, Lindl. but of this there is no proof. During his lifetime Griffith uses the name *Abies densa* for the Sikkim fir. Griffith's Notulae and Icones were both published after his death by M'Clelland who was a fellow of the Linnean Society and probably had ideas of his own upon the subject. In the Notulae IV, p. 19 the plant is called "*Abies Webbiana* ? Pl. CCCLXXI. A densa, Griff. Mss Itinerary Notes p. 141, No. 662." In the Icones the plate is called Abies Webbiana. M'Clelland undoubtedly made additions of his own when editing Griffith's works and it is probable that this change of name was due to M'Clelland. In any case the change of name does not

affect the nomenclature even if *A. densa* was abandoned by Griffith.

As regards the vexed question of the Himalayan firs I believe the matter would have been settled long ago if the first division had been made into an eastern and a western species. The Sikkim fir differs from the two western firs much more than these differ from one another. T. Thomson stated that the specimens of the Sikkim fir showed far wider differences both of cones and leaves from the western firs than these two do from one another (*vide* Madden, l. c. p. 97 in note). There are several references to the differences in habit both in the Himalaya and under cultivation in Europe. As, however, it is difficult to say how much these references rely upon original observation as against copying from other works I will only refer to Heinrich Mayr (Wald und Parkbaeume fuer Europa p 165 and 174). Mayr saw the Sikkim fir and the Low Level fir and noted the wide spreading umbrella shaped crown of the former and the narrow cylindrical crown of the latter and concluded at once that they must be different species. I do not think anyone comparing plates 465 and 473 in Troup's "Silviculture of Indian Trees," Vol. III, can maintain that they represent only one species. Fig. 465 is of course *A. pindrow* but *A. spectabilis* has the same habit.

Abies densa, Griff. has the shoots more hairy than is usually the case in *A. spectabilis*. The leaves are rather longer and broader. The male catkins are long and cylindrical often nearly as long as the leaves as is well shown in Griff. Icon. plate 371. In every Sikkim specimen of the cones whether mature or not I have found the acuminate apex of the bracts visible before the cones break up. In both the western firs the bracts are so short that they are completely hidden by the cone scales.

The confusion of the Himalayan firs has been increased by Wallich. Wallich as has already been noted sent specimens to Lambert of what he evidently thought were two species which he called *Pinus Webbiana* and *P. tinctoria*. Lambert in describing these as *P. spetabilis* gives the distribution "Gossain Than and elsewhere in the Himalaya." The Gossain Than specimens

were collected by Wallich on a spur or short lateral range of hills some 50 miles N. E. of Khatmandu and about 100 miles from the Sikkim border. Wallich apparently in his Catalogue followed Lambert and Don and gave up his unpublished name *P. tinctoria* and adopt *P. Webbiana.* Wallich's *Catalogue* bears the date 1828 and consequently was earlier than Lambert's Gen. Pin. 1832. From Wallich's herbarium now in Kew it is not possible to say definitely which specimens came from Gossain Than but a specimen of Wallich's in Bentham's herbarium from Gossain Than shows male flowers and matches *P. spectabilis* Lamb Gen. Pin. II (1824) t. 2, fig. B, so that *A. densa,* Griff. certainly occurs in Eastern Nepal. In his Catalogue Wallich although he suppresses his *P. tinctoria,* introduces a *P. striata,* H. Hamilton, No. 6058*c*. Hamilton collected largely in Nepal and Sikkim or Bhutan so that *P. striata,* Hamilton is probably *A. densa,* Griff. The sheet numbered 6058*c* in Wallich's herbarium is as far as can be decided on specimens in leaf *A densa,* Griff. Assuming the specimens in Wallich's herbarium to be numbered as in his Catalogue I take them to be as follows :—

No. 6056 *Abies pindrow,* Spach.

6058*a* *Abies densa,* Griff. *Abies spectabilis,* Spach. *Picea* (a small leafless twig).

b. Abies densa, Griff. and *A. spectabilis,* Spach.

c. Abies densa, Griff.

with such a mixture under 6058*a* it is evident that the localities cannot be relied upon.

Although there is no doubt as to the tree called *Pinus pindrow,* Lambert there is considerable difference of opinion as to whether this is a distinct species or only a variety of *A. spectabilis.* Royle, Ill. Bot. Himal. p. 350 considered it distinct. Arboriculturists in Europe and America such as Henry, Beissner, etc. do so too but their opinions are of little value firstly because most them quote from Henry and secondly because none of them appear to recognise *A. densa,* Griff. so that the differences they give between *A. Webbiana* and *pindrow* are for the most part differences between *A. densa,* Griff, and *A. pindrow,* Spach, rather

than between the High and Low Level firs. In favour of the two firs being varieties of one species we have the opinion of T. Thomson, West Himal. and Tibet, p. 86. This is the opinion of a man who knew both these firs in the field and may be taken against the opinion of Royle. Madden, l. c. p. 100 points out that the distinctions between *A. Webbiana* i.e. (*A. spectabilis*, Spach) and *A. pindrow* by the cones given by Don in Royle, Ill. Bot. Himal. seem to have been reversed. The same objections apply to the figure and description of *Pinus pindrow* in Lambert, Gen. Pin. III. Madden further remarks that the cones of *A. pindrow* are perfectly cylindrical: those of Webbiana nearly cylindrical, thicker and shorter. Scales of *pindrow* more prominently eared; bracteoles oval, obtuse, eroded, emarginate, the mucro of the same length as the border of the sinus; in *Webbiana* the bracteole is more rounded, scarcely emarginate, with thicker and longer mucro or apex. These distinctions as far as they go appear to be correct and the failure to observe that the figures in Lambert's and Royle's works are misleading has made much of the discussions on the two western firs valueless.

I gave a good deal of attention to these firs when in Chamba and came to the conclusion that in the field they can be distinguished though I know of no distinction which can be relied upon. *Abies spectabilis* usually has the needles very much shorter than *A. pindrow* but the length varies a good deal and the needles tend to be longer on cone bearing shoots and on young saplings than on the sterile shoots of mature trees. Both firs have a narrowly cylindrical crown composed of short branches but the High Level fir is more often seen growing in exposed places where the crown gets damaged and misshapen by wind than the Low Level fir so that a casual observation might lead one to suppose that they differ in habit. The shoots of the High Level fir are usually hairy when young but this is by no means always the case. The outer layer of the bark of the High Level fir is almost always whitish as though bleached by the sun in large trees but the same thing is found occasionally in the Low Level fir and I suspect in both it is due to slow growth preventing much exfoliation of the bark.

There is little doubt that they occupy separate areas and are scarcely ever found growing together. Gamble Man. Ind. Timb. ed. 2, p. 718, suggests that Brandis has seen them growing together but Brandis Ind. Trees, p. 692, contradicts this. Madden l. c. p. 96 *et seq.* gives an excellent account of the firs in Kumaon and Garhwal. According to Madden *A. spectabilis* commences 500—1,000 feet above the highest *A. pindrow*. This is also the case on the Chor in Simla district and in the Ravi valley of Chamba. In the inner valleys such as Pangi and Lahaul *A. spectabilis* is the only fir met with and it is there no longer a high level species, descending to 7,000 or 8,000 feet in Pangi as does also the birch, *B. utilis*. As a very general rule *A. spectabilis* is associated with birch and blue pine; *A. pindrow* with *Quercus semecarpifolia* and *dilatata*, deodar and spruce.

If the two west Himalayan firs occurred in widely separated countries they would undoubtedly be considered distinct species, differing from one another more widely than do *Cedrus Libani* and *C. Deodara*. Botanists at one time considered all the cedars forms of one species but the tendency now is to treat them as distinct species. As there is no mean of determining on botanical grounds when two allied forms should be considered varieties or distinct species, considerations of practical convenience should be given due weight. On the ground of practical convenience it is better to separate the firs and treat them as distinct species. If this is not done the Low Level fir should be called *A. spectabilis* var. *pindrow* a combination which does not appear to have been made before, so that still one more name would be added to those which have already been proposed. This means that the fir most often seen in the west Himalaya and the only one of any economic value hitherto, becomes a variety of the rarer species (using the word rarer to mean that the tree is inaccessible and not often seen rather than scarce).

In some specimens the High Level fir seems to differ markedly from the Low Level fir in anatomical characters and at one time I thought the two could be distinguished by the resin ducts in the leaves being median in the former and peripheral in the latter. Further examination showed that this character

breaks down and I have seen sections of *Abies spectabilis* with the resin ducts both median or both peripheral or one median and one peripheral. I mention this because Henry describes *A. pindrow*, var. *intermedia* a variety of the Low Level fir in Elwes and Henry Trees of Gt. Brit. and Ire. IV (1909) p. 756 which is supposed to differ from both the West Himalayan firs in having the resin ducts median. The varity was founded on a tree growing at Eastnor Castle and there is no proof that it is a Himalayan species at al. Henry refers *Abies Mariesii*, Masters in Bot. Mag. t. 8098 to *A. Webbiana* Masters thought it was a Japanese species. Judging by the type specimens in Kew *A. Mariesii*, Masters is *A. spectabilis*. Until, however, the silver firs have been properly understood in the Himalaya there is no use in discussing occasional forms cultivated in Europe and supposed to be of Himalayan origin. With the exception of Wallich's Gossain Than specimens there is no Nepalese material available so that it is not possible to say whether *A. spectabilis* stops somewhere in Nepal or whether it is connected to *A. densa*, Griff. by intermediate forms.

Abies spectabilis, Spach, is found in Hazara at high elevations in the Kagan Valley, in Kashmir, at the head of the Ravi valley in Chamba in Bharmaor. It is common in Pangi and Lahaul. I have seen it at high elevations in Kunawar. On the Chor, in Gharwal and Kumaon it occurs at high elevations and extends to the Nepalese border. East of the Kali valley we know nothing of it but judging by the other Himalayan conifers it probably does not extend much further. Of the principal Himalayan conifers only the blue pine is found both in the eastern and western Himalaya.

Abies pindrow, Spach, is found in Afghanistan and along the outer Himalaya to Garhwal. In central Kumaon according to Madden it begins to get scarce and local so that possibly it does not extend into Nepal. I did not meet with it anywhere in the Kali valley.

The distinctions between the silver firs can be set out in the following key :—

Crown broadly pyramidal, branches wide-spreading; carpellary scales or bracts with long acuminate tips which just appear between the placental or cone scales; male catkins one inch long, cylindric *A. densa*.

Crown narrowly cylindrical, branches short; carpellary scales or bracts hidden by the placental or cone scales and invisible till the cone breaks up; male catkins ·5 —·7 inch long, ellipsoid. Sterile shoots usually hairy when young with the leaves, ·5—1 inch long covering the shoots when viewed from above, distichous when viewed from below *A. spectabilis*

Sterile shoots glabrous with the leaves 1—2 inches long and arranged distichously when viewed either from above or from below *A. pindrow*.

The Himalayan spruces may be distinguished as follows :—

Leaves obtusely 4 angled with about two lines of stomata on each of the 4 sides; cone 4—6 by 1½—2 inches. *P. Smithiana*.

Leaves flattened but keeled on both surfaces with two stomatic band of 4—6 lines of stomata on the dorsal surface; cones 2½—4 by 1—1¼ inches. *P. spinulosa*.

The Himalayan spruce is *Picea Smithiana, Boiss. Fl. Orient.* V (1881) p. 700. The tree was first described as *Pinus Smithiana*, Wall. Pl. As. Rar. III (1832) p. 24. The distribution given is Himalaya and the collectors Webb, Govan and Blinkworth. Webb and Blinkworth are known to have collected in Garhwal and Kumaon and their specimens doubtless came from Garhwal or even further west as this tree apparently does not occur in East Kumaon (*vide* Strachey and Winterbottom's Kumaon Plants. Also Madden l. c. p. 87) Govan collected in what is now the Simla district. There is, therefore, no doubt as to what Wallich described though the figure t. 246 is badly drawn as pointed out by Lambert who refigures it in Gen. Pin. III (1837) t. 88. Lambert l. c. states that it is a native of Kumaon (*i.e.*, Garhwal) and Sirmur. The tree was renamed *Picea Morinda* by Link in Linnæa XV (1841) p. 522.

The Sikkim spruce is *Picea spinulosa, Beissner in Mitt. Deut. Dendro. Ges.* (1906) p. 83. Beissner's paper is dated August 1906 and quotes a note by A. Henry in Gard. Chron. XXXIX (1906) p. 218-219 in which the combination *Picea spinulosa* is made. Henry, however, calls the tree *P. morindoides*, Rehder in Sargent, Trees and Shrubs, and does not use the name *P. spinulosa* which he cites incidentally as a synonym. Thus although Henry's combination is a few months earlier, having been made in April, it loses priority under article 37 of the Vienna Congress Rules of 1905.

The tree was called *Abies spinulosa* by Griffith, Journal of Travels (1847) p. 259. Itin Notes (1848) p. 143. Icon. Pl. As. (1854) t. 363. It was redescribed by Rehder under the name *Picea morindoides* in Sargent, Trees and Shrubs (1903) p. 95, t. 46 and is figured in Bot. Mag. t. 8169 where Stapf enters fully into the question of its identity with the *A. spinulosa* of Griffith.

The Himalayan spruce is found from Afghanistan eastwards as far as the Alaknanda in Garhwal. In the inner Himalaya in Lahaul and Pangi in exposed places near the limit of its growth the needles are very much as shown in Wall. Pl. As. Rar. III t. 246.

The Sikkim spruce is only known in valleys in the inner range at 8,000—9,000 feet and in the northern ranges of Bhutan at 7,800 11,600 feet. It is rarely more than 50 feet high though if the observers quoted by Elwes (l. c. VI p. 1393) can be relied upon it occasionally reaches 200 feet in height by 13 feet in girth. These observations, however, seem difficult to reconcile with those of botanists who mention the spruce in their journals of travel in Sikkim.

R. N. PARKER.

GROWTH OF BAMBOOS.

In 1926 the rains ended very early and a large majority of the new culms of that year were only poorly developed. While looking at the Lachiwala bamboo plantation (*Bambusa burmanica*) with Mr. Bailey, the D. F. O. Dehra Dun, in June 1927, I enquir-

ed whether these half grown culms would continue their growth in the 1927 monsoon or whether they had accomplished all they were going to do. As no proper answer was forthcoming certain half grown culms were marked and kindly kept under observation by Forest Ranger Jamna Das. The record of these is given overleaf from which it will be seen that these bamboos do not necessarily complete their growth in one season. Troup's "Silviculture of Indian Trees," p. 979, implies that the principal height growth is completed in the chief rainy season and in from 2 to 4 months, and Osmaston's investigations on *Dendrocalamus giganteus* at Dehra (*Indian Forester*, Vol. XLIV, 1918, p. 52) showed that the height growth commenced in August and was completed in December. The figures now published clearly show that under certain conditions height growth can be continued in the second year. Further discussion on this subject will be welcomed.

C. G. TREVOR.

Statement showing the growth of the bamboo culms in the bamboo plantation at Lachiwala.

Serial Number.	20th June 1927		30th June 1927.		10th July 927.		20th July 1927.		30th July 1927		9th August 1927.		19th August 1927.		29th August 1927. Height.		Remarks.
	Ft.	Inch.	Ft.	Inch.	Ft	Inch.	Ft.	Inch.	Ft.	Inch.	Ft	Inch.	Ft.	Inch	Ft.	Inch.	
1	4	8	4	9	11	4	2	0	12	5	13	9	13	11	14	0	
2	6	7	6	8	12	5	2	5	12	9	13	0	13	4	13	8	
3	3	8	3	8	10	10	11	0	12	9	17	5	17	9	18	2	
4	5	10	5	10	6	8	8	9	12	10	17	2	17	5	17	10	
5	7	5	7	6	10	0	0	2	11	0	9	6	9	8	10	4	
6	6	1	6	1	7	5	8	4	10	8	14	0	14	2	14	9	
7	10	8	10	9	10	9	0	9	10	9	10	9	11	2	12	1	Very slow
8	5	10	6	3	10	7	1	0	13	4	15	2	15	4	16	0	
9	8	11	9	1	12	3	2	4	13	9	14	2	14	7	15	9	
10	9	7	9	10	12	9	13	2	13	4	15	10	16	5	17	7	

BAMBOO PLANTATION YEOTA, AKOLA DIVISION, BERAR.

A small plantation of *Bambusa arundinacea* about 13 acres in area was formed in 1884-85 in Yeota village of Akola division. For the next ten years no work was done Then the work was resumed and about 12 acres more were planted. The method employed for raising this plantation was as follows:—

The seed was sown in nursery beds 5 ft. by 5 ft. after the first shower of the rains. During the following winter and hot weather the beds were watered. After six months from sowing the seedlings were getting congested so they were pricked out in fresh beds, where they were carefully tended. When the seedlings were 12 months old and 1½ to 3 ft. in height they were put out in 3 ft. pits 10 ft. apart with two seedlings in each pit. The plantation was irrigated for two years.

The exploitation of this plantation commenced in 1902-03. In the Annual Report for Berar Circle for 1902-03, Mr. E. E. Fernandez wrote about the bamboo plantations in Berar in general and about the Yeota plantation in particular that the outturn from them "will not be less than Rs. 12 net per acre per annum, a figure far in excess of the revenue assessment on land of the highest class." The Local Government while reviewing the above mentioned report remarked that: "Mr. Fernandez hopes to realise a profit of no less than Rs. 12 per acre on some of his bamboo plantations in the Berar Circle and if this expectation is realised, cultivation of bamboos should prove exceedingly profitable." It is a pity that the annual returns of the expenditure on the formation and upkeep of this plantation and the revenue are not available for every year from 1884-85 onwards. But it is obvious from the records that only in two years 1920-21 and 1923-24 the revenue was less than Rs. 12 per acre. The total revenue upto 1926-27, was Rs. 11,497 while the total expenditure was Rs. 2,210. The average land assessment for Group II of Murtizapur taluq in which Yeota is situated is Re. 0-11-11 per acre, while for the whole taluq it is Re. 1-6-8 per acre (*vide* Report on the Settle-

ment of Murtizapur taluq by F. W. Francis). Thus it will be seen that even in the year of lowest revenue the figure per acre for Yeota bamboo plantation was higher than the average land assessment for Group II of Murtizapur taluq.

Apart from the financial results there is another aspect of these bamboo plantations which should not be allowed to be overlooked. The supply of bamboos in these tracts is a boon to the agriculturists, and the agriculturists round Yeota bless the name of the forest officer who started this plantation. In spite of such splendid financial results and incalculable benefit to the agriculturists we find that no special efforts have been made to extend bamboo plantations in Berar. Now and then some enthusiastic Divisional Forest Officers have tried to plant bamboos in suitable localities, but they are short-handed and have been unable to accomplish much.

This short note is written in the hope that it may draw the attention of the Local Government to this most lucrative form of national investment, which will also go a long way to help the development of agriculture in Berar.

S. A. VAHID, I.F.S.,
Silviculturist, C. P.

AFFORESTATION IN THE PILIBHIT CHANDARS.

There are three distinct types of chandars in the Pilibhit Forest division :—

1. Chandars that are fully stocked with sal shoots, the latter dying back almost every year, mostly during the frosty season and the rest during the fire season.
2. Chandars that are rather poorly stocked with sal shoots which also die back as in case of No. 1 above, and which contain grass and scrub over a large proportion of the area.
3. Chandars which are purely grass-lands with no tree growth in them.

The total area occupied by all the three types is about 35,000 acres which is nearly one-fourth of the whole division.

The origin of these chandars, amongst other things, has chiefly been attributed to some of these being stream beds at one time, some being the result of indiscriminate clear fellings in the past, some being at one time village sites, and others being exposed to accidental as well as deliberate burnings year after year.

Ever since the Pilibhit forests came under the scientific management of the Forest department, attempts have been made, now and then, to afforest these chandars but unfortunately no success has yet been obtained. At one time *shisham* (*Dalbergia Sissoo*) plantations were carried out on a vigorous scale in the Mustafabad and Mahof chandars, but the species, except only in the nursery beds, did not at all respond to the attention it received in the chandars, and frost in the winter and drought in the summer always had an upper hand in dealing with the plants. Recently teak was experimentally introduced in the nursery operations but the shoots that came up annually have so far been dying back every time. There is, however, a hope of this species coming out successful ultimately, as the new shoots that sprout out every year are always more vigorous than their predecessors, so that after several years' cutting back they would one day go up beyond the frost level, and drought does not seem to trouble the root-shoot cuttings of teak much here.

Previously to year 1925 there were only two nurseries in the division, one at Mustafabad and the other at Mahof. Chiefly *shisham* plants were raised in these nurseries some of which were allowed to remain and grow in the nursery beds and others were put out into the adjoining chandars. Almost cent per cent of the plants left to grow in the nursery beds survived and are at present showing a sapling crop of an average diameter of about 4" and average height of about 15' at the age of about 8 to 12 years. But hardly 5 per cent. of the chandar plants are now found alive; and these too are just managing to exist and no more. From this one may conclude that either there was something wrong with the method of planting adopted, or with

tending the plants afterwards, or that the localities selected were not suited to this species, for the progress in the chandars after about 10 to 12 years' work has been nil; and in nursery beds, of course, almost anything can be raised. However, rate of growth of *shisham*, even in the nursery beds, has not really been anything like what it should have been.

Sowing of teak, as noted above, was tried in the nurseries during the period 1922—1924, but without any results worth recording. Some plants, however that did come up, and are still surviving, gave an indication that this species in these areas would certainly do better than *shisham* especially owing to its habit of throwing out taller and stronger shoots every year after they are cut back. But no plants were ever put in the chandars to form that idea conclusively.

On assuming charge of the division after returning from Europe early in the hot weather of 1925, and after a short tour through these forests, the writer of this note was struck with feelings of a sort of despairing policy at the sight of the extensive unproductive blanks scattered throughout the length and breadth of the division, and so started making a special study of the problem of afforesting these areas. Teak seed after the usual treatment of alternate wetting and drying was sown on a fairly large scale in the existing nurseries in May and June, and planting of root-shoot cuttings of a certain number of available teak as well as *shisham* plants was done in the adjoining chandars early in July. Each cutting so put out was carefully taken with at least 1′ of root and 2″ of shoot in tact, and the pits into which these cuttings were put were 18″ to 24 deep, the whole area under operation being, of course, previously cleared of all grass growth. In some fresh chandars direct sowing of teak and *shisham* was done in prepared patches of 2 feet square. Two weedings were then carried out during August and September, and towards the end of the following October almost all the plants were noticed to have survived and their condition was very promising. Also all the old frost bitten teak plants in nursery beds, which were cut back in May that year, had now given out shoots which were over 9′ in height on an average. Germination of teak in the

nursery beds was over 50 per cent. and the seedlings looked very healthy, but the direct sowing in the chandars proved a failure this time also. During the following winter, all the teak and *shisham* seedlings died back as usual, and a certain number of the teak shoots were bitten by frost both in the nursery beds as well as in the chandars. However, the results of the year's work were very encouraging on the whole.

For the following year, therefore, undersigned proposed to carry out nursery and plantation works at a still larger scale, and with a view to effect greater control and supervision of afforestation and other works, put up a scheme of splitting the division from the existing 3 rather unwieldy ranges into 4, which was accepted by the Chief Conservator of Forests, U. P., the same year. The two existing nurseries were then included in the new Mahof range and in addition a new fenceless nursery in the Lalkuan chandar, and 3 more nurseries one in each of the other 3 ranges were created. *Shisham* and teak sowings were continued in the Mahof and Mustafabad nurseries, and only *shisham* was sown in the open nursery of the Lalkuan chandar. In Mala, Surai and Barahi, sowings of *Gmelina and khair* (*Acacia Catechu*) were also carried out in addition to teak and *shisham*.

Teak came up fairly well in all the nurseries except in Barahi and Surai and *shisham* did extremely well in Mala and Surai, whereas it was poor in Mustafabad and in the open nursery of Lalkuan, and almost failed in Mahof and Barahi. *Gmelina* and *khair* did well in Mala and failed everywhere else. Mango was also sown in the Barahi nursery and in fact that was the only species which came up well in that locality. Planting of root-shoot cuttings of teak and *shisham* gave equally good results as in the previous year.

In addition to the above, certain experiments were carried out in the No. 1 type chandars with a view to find out means for helping the existing sal shoots to overcome the trouble of frost. It is very noticeabe that sal growth in the vicinity of roads passing through chandars does often succeed in getting above frost level. This is probably due to better circulation of air. In

November 1926 a number of lines, one chain wide, were, therefore, cleared of all grass growth across the chandars in all possible directions, in some cases burning the cut grass at the spot before the frost season started, and in other cases leaving the cut grass lying in the area. Again in some cases the number of shoots on each root stock was reduced to one, the most vigorous ones being left to grow, and in some cases in addition to clearing the grass, the ground all round each root stock was hoed up—all this with a view to help the individual shoots to develop more vigorous growth both in height and girth. The sal shoots did respond to the help given to them both in putting on accelerated growth, as well as in withstanding the frost attacks till about the 1st week of January this year, but the later frosts of January and February were so severe that almost all the shoots were killed. But this year even large sized coppice shoots growing under the shelter of standards were bitten; and it was no doubt an exceptionally bad year for frost throughout the U. P. No definite conclusions can, therefore, be arrived at from the experiment.

Another new work done during the same year was of planting *shisham* cuttings on the firelines early in the rains. It will be noticed that *shisham* with close canopy effectively kills out grass. This property is, therefore, an indication to encourage its introduction on firelines for several reasons, namely :—

(1) Saving an expenditure in clearing fire lines annually.

(2) It is in full foliage during the fire season and would act to some extent as a fire screen.

(3) It would turn areas at present unproductive into productive areas covered with a fast growing and valuable species.

A certain number of root-shoot cuttings were, therefore, put out 4′ × 4′ on the Surai-Jhankaiya fireline as well as on the Mustafabad fireline. Under the side-shelter afforded by the high forest growing on each side of the firelines and also owing to free circulation of air on the lines no shoots were killed back by frost and almost all the plants are now doing well. The work is, therefore, certainly well worth being continued further.

There was also an interesting experiment carried out, on rather a small scale, in a blank area of the Lalkuan chandar. About a quarter of an acre of the land was first hoed up about 9" deep all over, and then alternate ditches and ridges were prepared in it, the former being 4' wide and 4' deep below the ground level, and the latter being 6' high above the ground and 2' wide at the top. Large sized root-shoot cuttings of *shisham* were then planted at the top of these ridges. This was done with a view to get the shoots from these cuttings going up straight above the frost level in the very first year of their growth With the exception of some cuttings not giving out shoots, the result of the experiment was just as was desired, and some of the shoots of these cuttings in their second year now, are about 12' above the ground level. The experiment was instructive in so far that if expense were no consideration a successful *shisham* plantation can be raised in these chandars straight off.

There is just an important point yet to be noted about the results of the nursery works of Mala. A part of the *shisham* and *khair* areas and the whole of the teak and *Gmelina* areas were hand-watered during April and May 1926, and again during the following December and January, and the same were not affected by frost to the extent as the adjoining unirrigated areas, in spite of this year being exceptionally frosty. These plants are now making an outstanding feature of the nursery.

Taking a hint from this fact *khair* was shown (in 18" square and 6' apart patches, as advised by the Silviculturist, U. P.) in April, and teak was broadcasted in May this year in the same nursery, and arrangements were made for regularly irrigating the areas during the hot months. About a week after sowing, the *khair* started germinating and in another 2 or 3 days' time all the seed had germinated. There was a part of the *khair* area which could not be irrigated, and nothing came up there before the end of June, by which time the irrigated plants had already grown up to about a foot in height. The irrigated plants are now (September) 4' to 6' in height, and look vigorous and healthy, whereas the unirrigated ones are hardly about 1½' in height and

look rather sickly. Teak also has done better than in previous years but not so well as *khair*.

Results obtained from irrigation are, therefore, conclusive, but it is expensive to hand-water on a large scale. As the Pilibhit range chandars are not situated within a reasonable distance of any of the Sarda canals, a scheme for carrying out *taungya* cultivation in the Mala chandar (to begin with) was drawn up by the undersigned in consultation with the Conservator of Forests, Eastern Circle, and the same has now been approved by the Chief Conservator of Forests, U. P. Necessary steps for putting it into effect will, therefore, be taken from the next *kharif* crop

As to the work done in the other areas during this year, a number of different species were sown both in the nursery beds as well as direct in the chandars. Germination of *Gmelina*, *siris (Albizzia spp.)*, *semal (Bombax malabaricum)*, *jamun (Eugenia spp.)*, *neem (Azadirachta indica)*, bamboo, *chir (Pinus longifolia)* and *mahua (Bassia latifolia)* has been fairly good almost everywhere. Teak and mango have done well only in Surai and Barahi. Root-shoot cuttings of both *shisham* and teak have also done well, the shoots of this year's plants being now about 2½' and of the previous year's plants about 4' in height in the Mustafabad and Mahof chandars. In addition to the teak and *shisham* cuttings, a number of large sized green stakes (about 8' long and 1¼' in girth) of *pakar (Ficus Rumphii)*, *jhingan (Odina Wodier)*, *kharpat (Garguga pinnata)* and mulberry *(Morus spp.)* were put out in July last in four different chandars, as such large sized cuttings of these species generally take root and give shoots. This is done with a view to get some sort of shelter provided quickly for the sal shoots which may thus be protected against frost. Almost all the *jhingan* and *kharpat*, and a number of *pakar* and mulberry stakes have given out shoots, and it is hoped they have also taken root. If this experiment succeeds then there will be something coming up in the chandars in the very near future.

Now to come to the question of dealing with the chandars by irrigating them from the Sarda canal and its branches that run

throughout the length and breadth of the division. The object in irrigating the No. 1 type chandars would be two-fold, namely :—

(1) In the winter season watering would reduce the intensity of frost and enable the existing growth of sal to grow up instead of being cut back by frost.

(2) In the hot season it would stimulate accelerated growth in shoots and thus enable them to go up above the frost level much quicker.

No. 2 type chandars will also be treated in the same manner as No. 1, but in this case the blanks will be filled up with some fast growing species, preferably mulberry, with a view also to get some shelter trees for the existing sal shoots as soon as possible.

In No. 3 type areas raising of any tree growth should be considered a great boon, and if mulberry could be successfully raised it would be a still greater achievement. The idea of introducing mulberry into these chandars carries with it a future scheme for starting sericulture in these plantations; and the industry is now in great demand in the United Provinces.

An irrigation scheme is, therefore, being drawn up by the writer of this note in consultation with the Conservator of Forests, and it is hoped that when the canal is in working, water may be available for irrigating the Pilibhit chandars, restocking of which will be a very great reward indeed to the Forest department.

M. Z. HAQ, P.F.S.,
Divisional Forest Officer,
Pilibhit division.

TREE BENCH MARKS.

Experiments in use of tree bench marks carried out by the Survey of India at Dehra Dun between the years 1914 and 1926.

The success attending the use of tree bench marks in Canada led to an investigation of the behaviour of such bench marks in India.

It is not often that levelling is carried out through wild or forest areas and, generally speaking, there are numerous perma-

nent structures on which bench marks can be inscribed, as well as suitable sites for the erection and preservation of specially constructed marks.

2. There are occasions, however, when levelling has to be carried through a forest area in order to connect up two settled areas of land. Such a condition will possibly be encountered when the Indian levelling net is connected up with the Burma levelling of precision, should this projected work be undertaken in the near future.

Apart from the above special case, it is desirable to know what reliance can be placed on a tree bench mark—the life of a tree bench mark is limited by the life of the tree, but it is open to question whether the permanence of an inscribed bench mark on, say, a culvert, is as great as that of a tree bench mark. This investigation will also help us to arrive at some conclusion on the question of including tree bench marks amongst the category of the regular bench marks we pick up in primary and other levelling operations.

3. In Canada lines of levels are very frequently run through forest areas, and the conclusion arrived at by the Canadian Survey Department are outlined in Appendix I.

No figures are given in support of their contention that the bench marks do not alter, but it may be taken that they are satisfied that such is the case.

4. In the experiments carried out the following was the procedure :—

(*a*) Three types of the bench marks were made :—

Class A Zinc plate fixed on heart wood of tree.
„ B „ „ „ on wood below bark of tree.
„ C „ „ „ bark of tree.

(*b*) Eleven such bench marks have survived the 12 years (one tree having been cut down), and these 11 bench marks have been connected at intervals with the Standard Bench Mark in the Geodetic Branch Office grounds.

(*c*) Heights were determined both before and after the monsoons

A table has been drawn up, showing the difference between the mean height over the whole period, and the original height.

This table also shows the probable error of any one height value as derived from the discordances between the several values taken during the epoch. The bench marks are here shown in order of value of these probable errors, and it at once becomes evident that class A, cut on heart wood, is the most reliable; of the first six in order of reliability, five being of this class.

We can thus at once discard classes B and C as inferior, and confine ourselves to a discussion of c ass A

From Table 1 we get the information in Table 2. In column 4, Table 2, we have allowed ·002' as being the probable error of the observation, and by combining this with the probable error in column 3, we obtain a figure showing us the probable accidental error due to movements of the tree itself.

The average accidental error due to tree movements of bench marks class A appears to be ·004'.

6. It is evident that having added such a large accidental error to the result of our determination of height, we shall have to reject the value given by a single tree bench mark for High Precision purposes.

The average P. E. (probable error) of determination of height of the 5 bench marks class A noted in Table 2, column 3, is ·005'. This is practically all accidental error. Presuming we wish to fix the level of one reference point from the group of these 5 bench marks in Table 2, the probable error of the resulting height of the reference point would be approximately $\frac{\cdot 005}{\sqrt{5}}$, *i.e.* ·002'.

This would suffice for H. P. levelling, but any less number than 3 would not suffice.

It is difficult to see, therefore, how tree bench marks can be included in High Precision lines in the ordinary way.

Mathematically perhaps the fore and back levelling of lines containing tree bench marks could be adjusted by assigning a lower weight to each tree bench mark, which would amount to practically neglecting its value in the matter of discordances between fore and back levelling. But this is not a practical

solution. The only practical solution would be to have groups of 5 or 6 tree bench marks connected as small branch lines to the main line, so that the error would not come into the main line of levelling.

The latter method might quite possibly be of use in crossing a jungle area. Suppose there were rest houses or clearings of sorts every 10 or 15 miles and that the leveller could not find any kind of permanent mark in the intervals, then a series of branch lines, with groups of 5 or 6 tree bench marks on each, might be the only solution in order to retain good values for canal or road engineers for the future.

A group of 5 or 6 in good condition would also suffice for H. P. levelling operations as having a value of one ordinary bench mark.

8. For double levelling of precision, now termed secondary levelling, we would expect a single determination of height to have a probable error of $\pm$ ·004. We can therefore say that a group of two tree bench marks would have the same weight as one ordinary permanent bench mark.

For irrigation purposes, where a discrepancy between levellers of ·007 per shot is allowed, we could treat the value of a tree bench mark as having a weight equal to an ordinary bench mark.

9. The resulting conclusions are :—

(*a*) Tree bench mark shou d always be placed on heart wood.

(*b*) Tree bench marks should not be included in lines of levelling of High Precision, but groups of 5 or more may be included in branch lines.

(*c*) For levelling of secondary precision a tree bench mark is sufficiently good, when the levelling is for irrigation purposes.

U. R. Cotter, Lieut-Colonel, I.A.,
In charge No. 17 Party (Levelling).
Survey of India, Dehra Dun.

TABL

TREE BENCH

Table showing Probale Error of a

Classification :—

A. On heartwood

B. Bark removed,

C. On bark of

Bench Mark No.	Classification.	δ L = Changes in level					
		Mean height—original height. = Δ L	April 1914.	October 1914.	April 1915.	October 1915.	May 1916.
		Ft.	Ft	Ft.	Ft.	Ft.	Ft.
23	A	−·004	+·004	000	000	+·002	000
21	A	+·008	−·008	+·001	−·003	−·004	+·002
8	A	+·008	−·008	−·004	−·006	−·006	000
2	B	+·014	·014	+·013	+·006	000	·005
24	A	−·004	+·004	+·010	+·012	000	−·001
22	A	+·014	−·014	−·005	−·003	−·007	−·003
6	B	−·010	+·010	−·013	+·001	−·007	−·008
1	B	+·014	−·014	+·009	+·001	+·001	+·007
9	B	−·026	+·026	−·011	+·017	−·005	+·007
17	C	−·002	+·002	+·014	·032	−·005	+·003
5	C	−·005	+·005	−·004	+·063	−·013	−·017

E 1.

MARKS.

single observation at any time.

of tree.

bench mark on wood below bark.

tree.

from mean of 1914 -26.					P E. of a height taken at any time. $6745 \sqrt{\frac{\Sigma(\delta L)^2}{(n-1)}}$
October 1916.	April 1917.	November 1917.	May 1923.	May 1926.	
Ft	Ft.	Ft	Ft.	Ft.	Ft.
+ ·003	+ ·001	+ ·001	·005	·007	± ·002
+ ·006	+ ·001	·002	+ ·007	- ·004	± ·003
+ ·003	+ ·001	- ·001	+ ·014	+ ·002	± ·004
+ ·006	- ·002	+ ·003	- ·002	·010	± ·005
+ ·005	·000	- ·007	- ·002	- ·021	± ·006
+ ·004	- ·002	- ·006	+ ·022	+ ·009	+ ·007
+ ·011	+ ·017	+ ·007	- ·012	- ·005	± ·007
+ ·025	- ·001	- ·003	- ·003	- ·018	± ·008
+ ·003	+ ·001	- ·007	- ·016	- ·015	± ·009
+ ·002	+ ·012	+ ·015	- ·002	- ·009	± ·009
- ·009	- ·017	- ·003	+ ·005	- ·008	± ·016

TABLE 2.

Tree Bench Marks.

Table showing Probable Accidental Error due to movements of Tree Bench Marks.

Classification :—

A. On heartwood of tree.

B. Bark removed, bench mark on wood below bark.

C. On bark of tree.

Bench Mark No.	Classification.	Probable error of a height taken at any time :— = M	Probable accidental error due to movements of tree bench mark, *i.e.*, $\sqrt{M^2 + \cdot 002^2}$	Remarks
		Ft.	Ft.	
23	A	± ·002	± ·000	
21	A	± ·003	+ ·002	
8	A	± ·004	± ·003	
24	A	± ·006	± ·006	
22	A	± ·007	+ ·007	
		Average P. E ± ·005	Average ± ·004	

APPENDIX I.

Tree bench marks are not used on lines of Precise Levels unless for purposes of temporary reference. They are used during the survey of the initial meridians and base lines which run through the outlying portions of the country in advance of all other surveys. During the survey of these lines transportation is very difficult. On such surveys it is practically out of the question to establish really permanent bench marks, except on the rare occasions when they can be established on rock.

The objections to tree bench marks are not based on questions of constancy of elevation, but on the want of permanence

of the tree itself. The mark cannot last longer than the tree. Conditions governing the life of a tree are so entirely different, not only in different countries but in different parts of the same country, that this method can only be decided locally. A tree's life is bounded not only by its natural span, but by the tree's local liability to catastrophy from wind, lightning or forest fire and further by the chance of its being cut down for any of many possible reasons.

There are no serious objections in the way of constancy of elevation, so far as regards trees in Canada, in all of which the annual addition of wood takes place on the outside, while the inner bulk of the tree does not change from year to year. Conditions may be different with such trees as palms, whose method of growth is different. As regards tree in Canada, the following opinion was obtained from the Chief of the Tree Planting *Division, Forestry Branch*, some time ago :—" In reply to the enquiry as to whether a nail driven horizontally into a tree about 3 feet from the ground would remain at the same elevation, the answer is that there would be no change, no matter how long the tree lived. The spot would not become any farther away from the ground. The only chance of a slight difference of elevation, would, perhaps be in the case of a very small tree becoming slightly heaved up by frost or if soil might be washed in and cause a very slight rise."

In regard to the *actual mark placed on the tree, probably* this would be governed by different conditions in India and in Canada. In north-western Canada, where tree bench marks are being established, the trees are not large, seldom over 18 inches in diameter, and the trunk does not expand as it nears the ground but goes almost straight down In order to hold a level ing staff on the mark, either a large piece must be cut of the side of the tree, seriously handicapping its life and its ability to resist wind or else a bolt or spike must be driven into the side of the trunk. Where questions of transportation allow its use, the best bolt is one sufficiently long to be driven in firmly and to project enough to hold the staff, and sufficiently strong to withstand wilful disturbance. A bolt nine inches long, of circular section, half

an inch diameter, driven so as to leave 3 inches projecting, has been used here. The cutting edge is chisel-shaped as it drives more easily than a point, and the bolt is of a round section as it is difficult to drive a square section and keep one side horizontal. There is no difficulty in driving the bolt so that its length keeps horizontal. The bolt is generally placed about 3 feet above the ground but this is chiefly to facilitate finding it if there should be snow on the ground. So far iron bolts have been used, but some form of bronze would have advantages. No hole is made for an iron bolt, it is simply driven in, but in the case of a bronze belt, a hole of slightly smaller diameter could first be drilled in the tree and the bolt be then driven in firmly. There is no head on the bolt, the place where the rod is to be held is marked with a file on the top of the bolt after it has been driven, or better a horizontal slit is sawn across the head of the bolt and the staff is held on a chisel inserted in the slit and levelled by a hand level. The tree is identified by having a "blaze" cut out of its bark immediately above the spike. The letters "B. M." and the No. are cut on the wood where the tree is blazed and its position is recorded with reference to the nearest survey post, in addition to recording the kind of tree and its diameter. The reference to a survey mark is easy as the survey line is one long straight line across country with an iron post established every half mile. The reference consists of the exact distance measured along the line from the nearest post together with the rectangular offset to the tree.

Where transportation is more serious, the size of the spike has to be diminished, but the smallest used is a 6 inch nail, projecting one inch. Tree bench marks are established every half mile or one mile according to the trees available. There are generally plenty of trees, but rock is always used in preference, if it occurs, forest fires being a serious danger to trees in Canada. Even if the tree is only scorched, it soon blows over

In regard to any mark left on a tree it is, of course, to be recollected that, no matter what its nature may be, it is liable

to be covered up by the tree's growth. In Canada a tree will expand radially on every side about one inch in 12 years between 20 and 100 years of age, and there are few trees which have escaped fire so long as to have passed the stage of their rapid growth before they are used as bench marks. A "blaze" cut on the tree down to the wood below will remain indefinitely but in the case of some kinds of trees here it becomes entirely covered up by overgrowth from the edges in about 25 years. After this occurs the wood forming over the blaze will expand outwardly and only a slight discolouration of the bark will show that the tree was ever marked. A spike will similarly gradually become embedded in the tree, so that it may happen that a staff can no longer be held on it. This, however, is of small consequence so long as the tree can be identified. Even if the spike is entirely covered it can be found by cutting and its elevation taken by using a steel rule and a hand level in conjunction with the staff Of course conditions of growth are different in different countries, and with different ages of the same tree.

Where a tree's trunk expands greatly as it nears the ground, a mark could be made by driving a large copper nail vertically into a root after cutting away the bark, but this does not appear to have any advantage over a mark in the trunk except that it may be less liable to wilful disturbance. There is more chance of movement in a root, either from wind or if the root is forced to expand, as a whole upwards. This would almost certainly occur with a root some distance from the base of the tree.

Tree bench marks should be placed on healthy growing trees and the less interference with the tree the better. If it can be identified without any cutting of the bark it is better to make no mark. An iron bolt should do no harm, though possibly other metal might be injurious to a small tree.

Bench marks should not be placed on stumps no matter how firm they may appear. They quickly become unstable. Provided the tree is healthy and a little on the youthful side of its prime, the larger the tree the better.

In Canada, owing to the great depth to which frost penetrates with the results that no artificial mark with its foundation less than six feet below the surface is really safe from slow upheaval, the question of an artificial mark, more permanent than a tree, for use on the outlying surveys is probably a more difficult one than in India. It is this trouble from frost which makes recourse to trees, even though small ones, necessary in these surveys.

While our tree bench marks are so situated that there has been no opportunity to test their constancy with any permanent bench mark of the class established on our Precise Levels, yet there seems no reason to consider that their constancy is limited except by the question of the existence of the trees themselves. If conditions are such that the tree will last a long time, there should be no objection to such bench marks. The difficulty here is that the average life of a tree is comparatively short.

TREATMENT AND CARE OF ELEPHANTS.

By Dr. M. C. Gupta (Late Medical and Veterinary Officer. Messrs. Macgregor & Co., Ltd, Burma, Toungoo, 1924).

The "cure" of disease was formerly regarded as the chief function of the practitioner Implicit faith was placed in drugs and methods of treatment; to-day prevention is considered better than cure. If certain rules are observed, elephants may generally be kept fit for forest work. Few rules are necessary, but these few should be strictly obeyed. They are (1) washing, (2) grooming, (3) grazing, and (4) rest.

Washing.—First and foremost a good and invigorating bath should be given to the elephant early every morning as soon as the animal is brought in. To effect this, wherever possible, a good running stream should be selected The usual custom amongst Burmese mahauts is to stand the elephant in water and to throw some water over it with their hands, a clumsy way to give an elephant its bath The proper procedure is to do grooming and washing together. As soon as the elephant is made to lie down in the water the whole body should be properly scrubbed with some hard substance such as a brick. The Indian mahauts use

burnt bricks, each mahaut taking his brick in his hand as he goes to wash his charge. In the sick camp I have tried scrubbing brushes which are as good as burnt bricks, but the cost of these is prohibitive. I have endeavoured to burn some bricks, but they have not turned out as good as the Indian ones. The Indian scrubbing bricks are light, spongy, and scrub the elephant's skin well. This sort of grooming will prevent skin diseases such as "thwesuma" (blind boils), abscesses, etc, gives the skin a healthy appearance and promotes the circulation of the blood The Burmese mahauts sometimes use "*Do Nwe*"—a creeper which fulfils the same function as soap. Mahauts when bathing their elephants generally forget to clean out the ear cavities. It is a common thing, when inspecting an elephant, to find septic sores in the ear—obviously the result of improper attention at bath time Assistants, as a rule, should make a point of examining the ear cavities whenever they inspect an elephant. In the hot weather, when water in the streams becomes scarce, a well should be dug both for bathing and drinking purposes The well should be often changed to keep the water free from contamination.

Grazing.—Good grazing is the secret of the elephant's good health. Every-day experience shows that mahauts do not trouble to take their elephants to suitable grazing, they generally loose them just outside their camps and the animals have to find their own fodder. This, under no circumstances, should be permitted. The *Sinoks* (elephant headman) should have strict orders that the mahauts are to take the elephants to good grazing some distance away from their camps. Grass is the natural food of elephants. *Kaing* and *kyu* are the chief varieties which elephants eat with relish. *Wa ywet* (bamboo leaves) and *gonmin* plants are also favourite fodders. As regards artificial food for sick and weak elephants *san londi* (broken rice), paddy and boiled rice are generally used Paddy soaked in water for a couple of hours before use and with the husk removed, proved just as efficacious as rice itself, and cheaper.

To facilitate easy digestion and quick absorption these artificial foods should be given in small bundles of paddy straw or tender *kaing* grass As oil cake contains a large quantity of fat

this food is also used in the sick camp. It is first soaked in water and then mixed with paddy

There is perhaps no animal less liable to sickness than the elephant if well fed. This point is of paramount importance. It is common enough to see elephants in poor condition, suffering from noth'ng but starvation, and being given medicines for general debility, when their appetites are good, and they only require sufficient fodder to be cured. It may truly be said that all the ailments to which elephants are subject are directly or indirectly caused by insufficient feeding. Under-fed elephants become weak and unable to stand exposure; they cannot perform their work, and are subject to the attack of even such remote diseases as sun-stroke.

Rest.—If elephants do not have sufficient rest, no amount of food will keep them fit. Rest the animals when they look tired. The hot months are as tiresome to them as to us. Make it a rule to march your elephants in the hot weather before ten o'clock in the morning. Elephants generally sleep two to three hours, and the time at night they generally choose to sleep is between 1 and 3 A.M. Sometimes on a very hot day some animals will lie down in the middle of the day, this is an indication of a weak constitution.

General capacity of an elephant for work.—An elephant should on no account be considered merely as a beast of burden. In the hot weather the working hours for a dragging or *aunging* elephant are from 7 to 10 in the morning and 5 to 7 in the evening. Any time worked over this is to detriment of the animal's health.

Sore-backs.—Sore-backs are sometimes exceedingly tedious to cure. The mistake usually made is to allow the wounds to heal on the surface, while mischief may be going on inside. A free use of the knife, great care in cleansing the wound, and the application of antiseptic dressings are the best methods of insuring a speedy cure. The deep burrowing holes (otherwise called sinuses) generally present in sore-backs should be well packed with tow soaked in the antiseptic ointment. In deep sinuses of long standing camphor oil may also be found useful.

Purgatives.—When elephants require a purgative they eat a considerable quantity of earth, kicking it up with their toes and conveying it to their mouths with their trunks. Sometimes they eat from 3 to 5 lbs. They generally do this when troubled with internal parasites. Certain soils, usually black and impregnated with a kind of *natron*, are preferred. Purging ensues from 12 to 24 hours after they eat earth

Salt.—A daily salt ration should always be given, elephants in captivity cannot go to natural salt licks and this fundamental requirement must be made good.

Signs of health.—Continual motion of trunk, ears and tail, bright eyes, soft, pliant and freely moving skin, good appetite, mucous membrane of mouth, eyes and other external organs of a bright pink.

Detection of disease.—The early detection of disease is a matter of the greatest importance. If the malady happens to be an ordinary ailment, treatment applied in the first stages stands a better chance of being successful than if applied later on, and if the disease is infectious early detection will facilitate the adoption of measures to prevent its spread.

Symptoms of ill-health.—One of the first indications of ill health is a loss of appetite. This can be seen by the empty appearance of the elephant. While being "off his feed" denotes that there is something wrong with the animal, it must not be taken for granted that because the animal keeps on feeding there is not much the matter with him. Anthrax may be mentioned as one of the diseases in which the appetite of some elephants is retained, although the animal may be seriously ill. Therefore the retention of appetite in an elephant that is obviously ill may aid in the diagnosis of the disease from which it is suffering.

Elephant inspection.—When an elephant is inspected it must be observed very carefully. Eyes, ears, spine and the limbs should be seen. In fever and inflammations the mucous membrane turns red, when the liver is deranged it assumes a yellowish tint. Usually pale mucous membranes are a sign of weakness and debility, or are caused by some internal hæmorrhage, trace-

able to innumerable blood-sucking worms. The urine varies in colour, smell, and density according to the food taken. But usually it has a strong but not unpleasant smell and is greenish in colour. A clear urine or white sediment is not a good sign, and should be attended to. The dung should be bright green, fairly consistent but not dry, covered with slimy mucous and passed without straining.

Attention to these details and use of a few simple remedies will generally insure good health in the elephant camp Indian mahauts are addicted to the use of various dopes including opium most of which are probably either harmless or useless.

REVIEWS.

THE FOREST POCKET BOOK.

BY S. H. HOWARD, I.F.S., DIVISIONAL FOREST OFFICER, UNITED PROVINCES.

(The Superintendent, Government Press, U. P., Allahabad, Price Re. 1-8.)

By his latest publication Mr. Howard has deserved exceedingly well of his brother forest officers. Not only has he augmented our knowledge, but he has shown us how to reduce our baggage. In future we need neither cumber our carts with tomes of reference, nor our minds with formulæ. The D. F. O, or Ranger on his round, the W. P. O. out in the blue can alike afford to discard the bulky Troup or the unpocketable Schlich in favour of this thin little green volume, printed on India paper which fits so neatly in the tunic pocket. This book marks a distinct advance on the original U. P. Forest Pocket Book issued six years ago. It is more compact, and it contains infinitely more matter. It sets out to do for the forest officer what the Field Service Pocket Book does for the military officer. The idea is excellent; the execution no less admirable. There is but one major point of criticism. While a great part of the information contained in the work is of universal application and may profitably be made use of by foresters in any part of the Indian Empire, the silvicultural species dealt with and the notes on regeneration refer especially to the conditions found in the United Provinces and adjoining country. This limitation is unfortunate. It would perhaps be too much to say that a good ship has been spoilt for the proverbial ha'worth of tar; but certainly the inclusion of regeneration notes on the more important species of South India and Burma would not have appreciably increased the book's dimensions, but would materially have increased its circulation. As it is, while the United Provinces are treated to a "Private shower," like Alice's rose-bush, the less favoured provinces "look

up and are not fed." We cannot but feel that data for a work of such importance should have been compiled by the Forest Research Institute with the assistance of specialists from all provinces, and embodied in one Forest Pocket Book for all India and Burma. This would save the duplication of labour and expense by provinces, and experience obtained on a wider front would be more conclusive. Progress in silviculture, as in every science, is accelerated by imitation and the diffusion of data and ideas. However the author deserves every credit for his single-handed effort; if the universal Pocket Book ever materialises, it will be due largely to his initial enterprise.

The book contains seven chapters and an index. The first chapter consists of general notes on artificial regeneration derived from the author's own experience. Here he discloses several of the common causes of failure in plantations, and raises many interesting points. He explains the function of experimental work and shows how it consists properly in two stages, the first of which is expensive and uneconomic, involves continuity of work and records and should be confined to small areas. In the second stage, which demands larger areas, data is obtained for costs, labour and size of plantations. Not until these problems have been satisfactorily solved should working plan schemes be drawn up. It is important, moreover, that the easiest areas should be those first cultivated.

In the vexed question of artificial as opposed to natural regeneration the author sets forth clearly the comparative advantages of each method, and leaves it to the reader to decide in each particular case whether the cost of burning for say, thirty years, and the loss of two of the crop's increment over the same period, for example, would outweigh the expense of clear-felling with artificial regeneration, which may also involve, as experience in Europe and Nilambur has shown us, a decrease in the productive capacity of the soil.

Another point emphasised, is the economic value of pure crops, which in the present state of our Indian market, must often prove the decisive factor in our choice of species to the neglect of purely silvicultural considerations.

In considering the spacing to be adopted in plantations the costs of early thinnings must be balanced against the cost of weeding. Early thinnings can seldom be remunerative in India and the problem of thinning the vast number of new regeneration areas taken up throughout India within recent years will tax the ingenuity of future foresters. This problem has been considered by Professor Stebbing in Vol. III of his "Forests of India," page 457, where he points out that it was the impracticability of thinning the *taungya* plantations of the last century in Burma that led to the temporary abandonment of the system. In this instance, it would seem, we must be prepared to reconcile precept with practice and adopt a more open spacing, which if silviculturally unsound, is nevertheless the only policy justifiable on economic grounds.

In a note intended primarily for range officers, Mr. Howard does well to lay special stress on nursery organisation. Only through careful attention to the exact sequence of work, size of beds, registers of the stock available, etc., can satisfactory results be achieved.

In referring to irrigation of the nursery the author recommends that watering should be done in the morning and not at night. However much this opinion may be occasioned by his own wide experience, a word or two in its justification might have been expected, in view of the fact that it runs counter to the precept of several recognised authorities, *e. g.* Fernandez, "Manual of Silviculture." The best time of day for watering is, according to the experience of Indian gardeners and agriculturists, the afternoon. The explanation of this, so far as the hot weather is concerned is obvious, for watering early in the day would result in a very large per cent. of the water being lost by simple evaporation.

Brown, "Silviculture in the Tropics," says "If given only once, the evening is the best time for watering, except in localities and at seasons when frost occurs, where plants watered in the evenings are more likely to suffer from frost-bite."

The most effective method of conserving the water-supply in the soil is thorough weeding and soil working. One of the

common faults in artificial regeneration noted by the author is weeding when the soil is too wet and compact. Weeding should be done only when the soil is sufficiently dry to shake away fairly freely from the weed roots. Efficient soil working round the young plant is at least as important for preserving moisture as weeding. This is now generally recognised. It is not generally realised, however, that, as the author points out, this soil working is out of place in the hot weather when a hard crust of earth acts beneficially in retaining the soil moisture.

In this connection we are surprised to find no reference to mulching, a practice now employed very widely with excellent results in the drier forests of Bombay and elsewhere. Green leaves or twigs, covered with a spadeful of earth are spread round the plants in the rains. The effect is to prevent further weed growth, check evaporation in the subsequent dry season and secure the loosening and aeration of the soil by worms and insects, (*c. f. Indian Forester*, XLV. p. 82.)

Under the section entitled "Artificial Regeneration notes on important species" the author deals with twenty species, presumably the most important in Northern India. As far as they go these notes are excellent, and should prove of incalculable value to all forest officers concerned. We have referred above to the limitation of this book to the United Provinces, and therefore we are not surprised to find no mention of exotics (although the U. P. Forest Pocket Book of 1921 included Eucalyptus) but at the same time there are some species of wide distribution and considerable economic importance, such as *Pterocarpus Marsupium* and the *Lagerstræmias* whose inclusion might have been expected.

Miscellaneous Silvicultural Matters.—Some valuable information is given under this heading in Chapter III. The weights of seeds with plant per cent. are given in tabular form. It may be noted that the vernacular names of *kail* and *sain* have unfortunately been misprinted.

The tables of spacing for seedlings, standards and thinnings are particularly valuable, and the classification of thinnings, now

standardised in the U. P, has been supplemented with diagrams which should prove of very real assistance in the field. Yields, Volume and Outturn tables are given for the three main North Indian species; *viz.*, deodar, chir and sal, together with yield tables only for sissoo. A bark percentage table is included for a number of species.

Utilisation Notes.—A considerable mass of valuable information is compressed into this chapter. Seasoning notes deal necessarily only with that aspect likely to concern a divisional officer, *viz.*, air-seasoning, and the various methods of the latter are dealt with very succinctly, as also are the important corollary operations of stacking and storing. A list of refractory and non-refractory woods is appended. The wood preservation and strength of timber tables summarise admirably, for the benefit of the practical forester, the result of numerous experiments at the Research Institute; while two important branches of exploitation —sleepers and resin tapping—have each got a section to themselves, the latter having been contributed by Mr. J. E. C. Turner.

Engineering Notes.—In the small compass of fifty closely printed pages devoted to the subject there is a wealth of matter collected under heads too numerous to specify, and affording a valuable compendium of reference for all the constructional work usually undertaken in a forest range.

One rather serious misprint must be corrected. On page 259 the proportions given in the third column for a "Rich Mixture of Portland Cement Concrete" should read 3 instead of 8.

Chapter VII deals with miscellaneous subjects, ranging from elephants to the dentition of dogs. It would be easy perhaps for an individual reader to criticise the inclusion or exclusion of certain items, but careful consideration will convince that few points of moment for a touring officer have been neglected and little of what is included could readily have been dispensed with. The somewhat drastic treatment of imaginary snake bites will be read with diversion, and the section on proof correcting may serve to stimulate potential contributors to the *Indian Forester* by giving them some idea of what the editor has to contend with.

EXTRACTS.

WORK OF THE ORDNANCE SURVEY.

EXPERIMENTS WITH AERIAL PHOTOGRAPHY.

The annual report of the progress of the Ordnance Survey for the year ended 31st March 1927 (published by H. M. Sta-

tionery Office, price 9*d*. net) points out that photography from the air for survey purposes has made considerable advances in recent years, but there has been much doubt as to how far the method was applicable to the revision of Ordnance Survey large-scale maps, bearing in mind that, besides the need for accuracy in the topographical detail, the Ordnance Survey has to go into the questions of names, administrative boundaries, and other matters. It was decided that the only way to get reliable information on the subject was to put the method to a practical test, by revising a substantial area by the normal Ordnance Survey methods and at the same time to revise it independently, using air photograghs, and to compare the results in respect of their accuracy, speed and cost. Sanction was obtained for the necessary expenditure, and the experiment was carried out in an area near Eastbourne. The result showed conclusively that air photographs are sufficiently accurate for large-scale revison, and that their use saves a considerable amount of time on the ground. At present, however, mainly owing to inexperience of the staff, the method cannot be compared economically with the normal methods. Further experiment, extending over a period of years, is required, and arrangements are being made to this end.

The total number of maps printed in the year was 1,440,335, which involved 4,961,907 printings. The fine line drawing and small type introduced in 1912 for 1/2500 scale plans caused considerable expense in reproduction, the only advantage being that 1/1250 enlargements were improved, but at the cost of the appearance of the 1/2500 map. It has therefore been decided to revert to a large extent to the old style of the 1/2500 map, with bolder drawing and an increase in the size and face of the type. At the same time a new fount has been selected which it is hoped will improve the appearance of the map.

The Ordnance Survey estimate for the financial year 1927-28 is £241,335 gross, offset by £90,330 estimated receipts. For 1926-27 the gross expenditure and receipts were £241,675 and £92,650 respectively. In spite of the general strike, which

seriously retarded the sale of maps in the early part of the year, the sales have been well maintained. The net receipts for the year amounted to £57,998, an increase of £3,322 over 1925-26.

The revised edition of the map of Roman Britain has been completed and will be published shortly. Field-work has been carried out in Wiltshire, Yorkshire, and elsewhere, in connexion with the archæological publications of the Ordnance Survey. The usual additions have been made to the collections of photographs of old estate and other maps; of air-photographs; and of notes relating to newly discovered sites. The arrangement and cataloguing of these is now in progress. The assistance voluntarily given by honorary correspondents and others has increased. This has been particularly welcome in connexion with the revision of the Roman map, which could not have been carried out without such help.

Special excavation work has been carried out at Malton, Yorkshire, by Dr. Kirk, in order to determine the character of an earthwork. This proved to be a large and important, and hitherto unknown, Roman fort. The work was begun in order to decide what name the site should be given on the revised large-scale maps, and is mentioned as showing the good results of co-operation between Divisional Officers of the Ordnance Survey and local archæologists. The work of excavation is still in progress.—[*The Times*.]

BRITISH ASSOCIATION.

RENEWED WARNINGS OF A COMING TIMBER SHORTAGE.

The proceedings of the Forestry Sub-section, at the meeting of the British Association at Leeds, were resumed on Saturday last, Sir Peter Clutterbuck in the chair. Three papers were submitted.

Dr. T. F. Chipp, of Kew, took the subject of "Forestry in Relation to Climate and Erosion." The influence of climate on forests, he said, is generally recognised, and he gave examples

of that aspect with reference to recent work. Considerable controversy had arisen with regard to any influence forests may have on climate, but an examination of the principal climatic factors showed that the presence of a forest mass exerted an influence in its immediate vicinity. Historical evidence indicated not only that much more favourable conditions extended, formerly over many areas which were now uninhabitable or peopled only by nomad tribes, but also that some formerly arid regions were now enjoying a moister climate and a more luxuriant vegetation owing to the shifting of the great climate zone. No doubt the appeal to the rainfall factor was most convincing to the popular mind, but a sounder statement of the case was required for its acceptance by the scientist.

Mr. C. E. P. Brooks dealt with "The Influence of Forests on Rainfall." In the course of his paper he said that the possible influence of forests may be general, *i.e.*, on the rainfall of the whole district, or local, *i.e.*, confined to the actual forested areas. The general influence should depend on the relative amounts of water vapour passed to the air by forests, crop land and bare soil. Three processes are effective: evaporation of rainfall intercepted by foliage, evaporation from soil, and transpiration. The available data suggest that the total is greatest from crop land, least from bare soil. Hence, the replacement of forests by crop land should increase the general rainfall slightly, replacement by bare soil should decrease it. Owing to the variability of rainfall from other causes, it is difficult to find actual examples of these effects. In dealing with local rainfall, it is necessary to distinguish between the catch of rain and the true fall. The excess of rain generally shown by forest clearings over open sites is mainly due to the shelter of the gauges from wind eddies. The true fall over forests is found to average only one or two per cent. above that in the open ; this is due to the increase in the effective height of the ground caused by the forests. The latter are beneficial in conserving the winter snowfall

Prof. A. W. Borthwick, of Aberdeen University, read a paper on "Forestry in Relation to Water Catchment Areas."

In the afternoon there was an excursion to the Fewston Reservoir of the Leeds Corporation.

In his address on Monday, as President of the sub-section Sir Peter Clutterbuck declared that only one-tenth of the timber used in the British Isles was home-grown, and only one-fifth of the imported timber was Empire-grown. Canada, which was regarded as the store-house of softwoods within the Empire, now exported chiefly to the United States. Already 83 per cent. of her trade in such products was with the United States. The seriousness of the coming shortage was being realised, and generally steps had been taken in most parts of the Empire to start or improve forest management on scientific lines. But what had been done was not enough. Canada within 25 years would be no help to the Empire as regards softwood supplies; and unless steps were taken to afforest large areas, and establish permanent forests the prospects of the Dominon's future development would be seriously jeopardised. The arguments in favour of afforestation being undertaken on a large scale in Great Britain were :—The coming shortage of softwood supplies; utilisation of the more or less idle waste lands; enormous annual cost of imports; necessity of assured timber supplies for industries and for insurance in case of war; and, lastly, the extension of small holdings and increase of country occupations. But even if adequate afforesation schemes in Great Britain were decided upon, the timber resulting from such operations would not, in most cases, grow quickly enough to avert the threatened famine. Sir Peter moved that the Council of the British Association be asked to pass a resolution in the following terms: "The low percentage of productive forest area in Britain is a matter of grave concern, and in the national interest, it is urged that afforestation and re-afforestation should be largely expedited. It is further urged that encouragement and financial support should be given to the development of silvicultural research and education, as well as to the Empire Forestry Association and other societies participting in the advance of the industry."

Professor Borthwick seconded the resolution.

Professor Fraser Story said our importation of softwoods was something like 8,000,000 cubic feet a year, and he thought experts would agree that, to be in any way self-supporting, it would require us to have an area of 7,000,000 or 8,000,000 acres to meet the consumption.

The resolution was carried.

Mr. R. L. Robinson read a paper on "British Forest Policy."

Mr. A. C. Forbes, dealing with the "Maintenance of Permanent Softwood Supplies in North-Western Europe," said that with the exception of Germany and Italy, the industrial countries chiefly relying upon supplies of softwood imported from Northern Europe are those lying along the north-western seaboard, including Belgium, Denmark, France, Holland, Great Britain and Ireland. These countries have the lowest area of forest per head of population, and would feel most acutely any serious shortage. Their annual imports are, according to Mr. Fraser Story, about 600,000,000 cubic feet, their total consumption nearly 12,000,000 cubic feet. This does not include pulpwood or hardwood. Great Britain takes nearly two-thirds of the total import. The normal increment from 7,500,000 acres of conifers, of which about 66 per cent. are privately owned, is about 300,000,000 cubic feet, so that there is an apparent over-felling, or reduction of the capital stock, equal to 25 per cent. of the total consumption. Northern Europe possesses about 300,000,000 acres of coniferous forest capable of producing, under proper management, the whole of the industrial deficit elsewhere in Europe for all reasonable time. Sweden and Finland possess one-fourth of this area, and their forests are conservatively managed. Russia is at present an uncertain quantity. The present exports from Northern Europe of about 800 to 900 million cubic feet could not be greatly increased at present without over-felling.

The chief measures most likely to assure the maintenance of an adequate supply of softwoods are: (1) Better protection against fire and more intensive management of the existing forest area, (2) Conversion of unprofitable hardwood areas into coniferous forest, (3) Afforestation of land possessing a low

agricultural value, (4) The lowering of the *per capita* consumption of softwood timber by substitutes such as ferro-concrete, plywoods, and pulpwood from hardwood timber, etc.

In the course of a paper on "The Economic Balance between Agriculture and Forestry," Dr. J. D. Sutherland said it by no means followed that the utilisation of certain grazing land for forestry would have a material bearing on the country's food supply. Our timber consumption in value was about one-twelfth that in food. Was it too much to expect that, when the subsidies and assistance to agriculture were £16,000,000, the amount at present devoted to the making of timber through the creation of forests might not, in the same proportion, be £1,300,000 annually instead of £350,000? Could we afford to risk remaining behind other nations?

Dr. A. S. Watt dealt with "The Place of Beech in British Silviculture." He said the timber value of oak and ash is adequate justification for further planting of these trees. The same reason may not be valid for some other broad-leaved trees, but their use is justifiable on silvicultural grounds. This applies particularly to beech. In the past the value of beech as a shelter tree was appreciated and its continued use in this capacity is recommended. Neither climatic nor edaphic factors exclude beech from the major part of the plantable area of this country. Yet its reputation as the "Mutter des Waldes" has not secured general acceptance, nor led to its general use in the rearing of coniferous crops. The conflicting opinions are reviewed and the conclusion reached that the results of Mid-European research may be accepted for soils of the "brown-earth" type, but that a generalisation embracing podsoles is premature.

On Tuesday, Mr. W. Raitt, F. C. S., discussed the question of "Paper from Bamboo."

Mr. W. B. Turrill submitted a paper on the "Forests of the Balkan Peninsula," and Mr. S. Mukerji's subject was "The Forests of Kashmir."—[*Timber Trades Journal, 10th September 1927.*]

THE FORESTS OF THE BALKAN PENINSULA.*

BY W. B. TURRILL, M.SC., F.L.S., OF KEW.

The Balkan Peninsula, as the term is now used, is a large area of approximately 180,000 square miles bounded on the north by the Danube, Save, Kulpa, and a line from the head of the last to the top of the Adriatic Sea, and in the south-east, forming a nearly continuous bridge between Asia and Europe. The flora is the richest in Europe and over 6,500 distinct species even compares favourably with some tropical areas. Of course, the majority of these are herbaceous or suffruticose plants, but there are 114 species of trees and 300 species of shrubs. Of the trees 24 species are evergeen and 90 deciduous, but only seven are endemic to our area. As with the herbs and shrubs so with the trees there are many species which reach their eastern, western, or southern limits of distribution in the Balkan Peninsula. Thus in the Rodopes the common beech meets the oriental beech, while in Macedonia and Thessaly the silver fir meets *Abies cephalonica* and intermediates between them occur.

A GENERALISED ZONATION.

Altitudinal zonation is usually very well marked in the mountainous portion of all districts of the Balkan Peninsula and especially for the forest vegetation. A generalised zonation is as follows :—

A.—For the Mediterranean domain (*a*) macchia and *Pinus halepensis* woods, (*b*) oak, (*c*) conifers—*Abies cephalonica* and *Pinus nigra* as dominants.

B.—Central European (*a*) oak, (*b*) beech, (*c*) conifers.

In 1925 I made a careful study of the pine woods on the Lapad Peninsula and on the southern part of the Isle of Lacroma, near Dubrovnic. In both places the pine woods are well developed and form a marked contrast with the almost bare hill-slopes of Mt. Sergi, which I climbed the same week and which must have been similarly forest clad at one time. Some of the trees are fine specimens up to 1 m. in trunk diameter.

**A paper read before the Forestry Sub-section at the British Association meeting, in Leeds.*

The oaks of the Mediterranean domain are the most important forest trees with broad leaves. The evergreen *Quercus coccifera* and *Q. Ilex* have a wide distribution, both as shrubs and trees. They rarely form extensive societies as trees, except in Crete and the Peloponnese, but are frequent in all kinds of high forest and brushwood associations in the lower and hill zones. *Quercus ægilops* forms important woods from the lowland to the montane zones in the south, and collecting the cups and acorns for tanning material is an important industry in Greece and the Cyclades. The deciduous *Q. conferta*, *Q. lanuginosa* and *Q. robur* form important forests above 5-700m. Frequent associates are: *Cercis siliquastrum*, *Carpinus orientalis*, *Ostrya carpinifolia*, *Fraxinus excelsior*, *Castanea sativa*, and *Laurus nobilis*. *Castanea sativa* sometimes forms fairly pure consociations. The laurel woods of Dalmatia and of eastern Istria may be mentioned here. Where the community is of tree height very little undergrowth occurs. I have only found *Ruscus* where the shade is deepest. Liane-like sprawling and climbing plants occur in the denser parts and include: *Smilax aspera*, *Asparagus acutifolius*, *Clematis vitalba*, *Tamus communis*, and *Hedera helix*.

The wild cypress (*Cupressus sempervirens* var. *horizontalis*) is certainly wild in Crete and light woods occur in the Sphakia mountains between 300 and 750m. altitude. These formerly had a much greater extension than they have now.

The hill and montane coniferous forests in the south of our area are generally composed of *Abies cephalonica* in one or other of its varieties. Nearly all of the higher mountains are surrounded by a wide belt of such woods or their remnants and the lower ones are usually covered to their summits, or were before man interfered. The altitudinal limits of the fir woods vary considerably for different mountains and the causes of this need investigation. Probably rainfall maxima and distribution, winds, accessibility to lumbering, and altitude of the mountain mass are all concerned.

Pinus nigra has a wide distribution throughout the Balkan Peninsula and often forms extensive woods even in the lowest

mountain zone of the Mediterranean domain. In the Sabioncello Peninsula I have seen it accompanied by macchia undergrowth.

The manna ash-oak woods are especially characteristic of the lowland and hill zones of the transitional districts. In the Eastern Adriatic parts they are sometimes designated Karst woods. Characteristic components of these, as I have studied them in Istria, are: *Fraxinus ornus, Quercus lanuginosa, Q. sessiliflora, Q. cerris, Carpinus orientalis, C. betulus, Ostrya carpinifolia, Corylus colurna, Acer monspessulanum, A. campestre, Celtis australis, Prunus mahaleb, Pyrus communis, P. torminalis* and *P. aucuparia*. The woods are usually light and open and the undergrowth is rich and tends to merge into compact brushwood. The ground flora also consists of very many species, but herbs limited to woods are rare. *Æsculus hippocastanum* has a limited distribution in Epirus, Thessaly, Northern Greece, and Bulgaria. Like several other Balkan Peninsular trees it flourishes better in the British Isles than in its own country.

The woods of the Strandja range in South-Eastern Bulgaria and in Eastern Thrace have only been incompletely explored. They are partly Mediterranean, partly Pontic-Caucasian in composition and the special interest is the occurrence of the oriental beech with *Rhododendron ponticum* undergrowth.

I have now recorded *Fagus orientalis* from as far north as Varna and from as far west as Dardere in the Southern Rodopes. In July of last year we discovered a most interesting primitive forest between Baju and Dandere in a steep-sided valley, the sides of which come down almost precipitously from the *Fagus silvatica* zone into that of the oaks which clothed most of the hillsides. At 900m. we entered an almost pure wood of *Juglans regia*, which from 800 to 600m. was mixed with *Ostrya carpinifolia, Fagus orientalis, Corylus colurna, Carpinus orientalis, Fraxinus ornus* and *Quercus sessiliflora*. There was practically no undergrowth, even the *Ostrya* forming fine trees to 20m. or more in height. A stream ran down the valley, which was cool and moist. It was obvious that the *Juglans* and *Fagus* kept to the moist, relatively shady, valley, near the stream. *Ostrya* and *Carpinus* went higher up the slopes beyond the moister air of

the valley and *Quercus sessiliflora* was co-dominant with other oaks over all the hills up to 1,000m., where it was replaced by *Fagus silvatica.* Isolated trees of *F. orientalis* were traced down to 550m. We had the impression of being in a Tertiary forest.

The whole of the north-central, north-eastern and central parts of the Balkan Peninsula come within the Central European climatic zone and the flora and vegetation correspond. The ecological division of the forest-clad areas is chiefly dependent on altitude. In the lowland and hill zones, oakwoods predominate, with beech and conifer woods mainly limited to the montane and lowest high-mountain zones. Oak woods have a very wide distribution, occurring as pure communities or merging into mixed deciduous forest. The commonest species are *Quercus conferta*, *Q. cerris*, *Q. robur*, and *Q. sessiliflora*. The dominance or co-dominance and association vary locally.

Beech forests are characteristic of the montane zone in the Central European and some of the transitional districts of the Balkan Peninsula and penetrate southwards in the Pindus range. Under the climatic conditions existing on many mountains the beech has considerable powers of rejuvenation, after lumbering, at the expense of conifers, as I witnessed on the Suva Planina in Eastern Serbia in 1922. In the montane beech forests *Fagus silvatica* is sometimes unaccompanied by other tree species over considerable areas, but more often other broad-leaved and also coniferous species accompany it and may merge into a very mixed forest. The finest beech trees I have seen are some of those in the magnificent Rila Valley, where the primitive woods have a background of some of the finest scenery in Europe.

Conifer woods occur either above or alternating with beech woods. The common silver fir, *Abies alba*, and the spruce, *Picea abies*, are the most widespread species and are frequently dominant or co-dominant over considerable areas. In 1926, in a wild valley between Chamkorija and Rila, I passed through an open wood of *Pinus peuce* and considered its tall grey trunk and graceful foliage to form the most handsome of the European pines. *Pinus nigra* is a not infrequent associate of the fir and

spruce. Larch does not occur as a native in the peninsula. *Picea omorika* is limited to the mountains around the central and upper parts of the Drina basin in Western Serbia and Eastern Bosnia, and in a small area in Montenegro. It is one of the most noteworthy of the Tertiary relics in the Balkan Peninsula. The trees usually grow on steep hillsides not exposed to the extreme conditions of ridges and summits and are often accompanied by other conifers and by the beech. The omorika spruce does well under cultivation, both in the Balkan Peninsula and in this country.

IN PRIMITIVE WOODS.

*The primitive woods of the Rila Valley deserve special men*tion, since they are probably the finest in Europe. While they are mainly mixed, with fir, spruce and beech on the whole co-dominant, there are local patches of one or the other of these in almost pure societies. No cutting is allowed in this area, and the humus is deep even on the slopes. Tall trees blown down by storms rot where they have fallen and all stages of their decay can be traced down to a stretch of wood humus. Around Chamkorija there are, again, very fine conifer woods of fir and spruce. Many of the full-grown trees reach to a height of 25m. or more and have their branches festooned with lichens.

The forest limit in the Balkan Peninsula is usually formed by conifers, though beech, either pure or accompanying the conifers sometimes reaches to or beyond the edge of the closed forest.

Deforestation has been man's chief crime against nature, and perhaps against himself, in the Balkan Peninsula. Whatever may be true for the parts bordering the Mediterranean, there is no doubt that the interior should be covered with forest over most of its area below the altitudinal tree limit. The various causes of destruction were all active in earlier ages as now, though not equally so.

The present States of the Balkan Peninsula have legislation for the protection of forests.—[*Timber Trades Journal, 17th September 1927.*]

THE BAMBOO PAPER INDUSTRY (PROTECTION) ACT, 1927.

The following Act of the Indian Legislature received the assent of the Governor-General on the 21st September, 1927 :—

ACT NO. XX OF 1927.

An Act to amend the law relating to the fostering and development of the bamboo paper industry in British India.

Whereas it is expedient to amend the law relating to the fostering and development of the bamboo paper industry in British India; It is hereby enacted as follows :—

SHORT TITLE.

1. This Act may be called the Bamboo Paper Industry (Protection) Act, 1927.

AMENDMENT OF ACT VIII OF 1894.

2. (*1*) In the Second Schedule to the Indian Tariff Act, 1894 (VIII of 1894), there shall be made the amendments specified in the Schedule to this Act.

(2) The amendments made by sub-section (*1*) shall have effect up to the 31st day of March, 1932.

RETROSPECTIVE EFFECT IN CERTAIN CASES.

3. Printing paper (excluding chrome, marble, flint, poster and stereo), containing no mechanical wood pulp, on which a duty has been paid at 15 per cent. *ad valorem* under item No. 99 of Schedule II to the Indian Tariff Act, 1894 (VIII of 1894), between the 21st of September, 1925, and the commencement of this Act, shall be deemed to have been liable to pay duty at one anna per pound under item No. 155 of that Schedule; and any deficiency between the duty which has been paid on such paper and the duty hereby made payable shall be deemed to be duty short-levied within the meaning of section 39 of the Sea Customs Act, 1878 (VIII of 1878), and that Act shall apply accordingly.

AMENDMENT OF ACT XXV OF 1925.

4. The second item of the Schedule to the Bamboo Paper Industry (Protection) Act, 1925 (XXV of 1925), is hereby repealed.

THE SCHEDULE.

AMENDMENTS TO BE MADE IN SCHEDULE II TO THE INDIAN TARIFF ACT, 1894.

(See section 2.)

For Items Nos. 155 and 156, the following shall be substituted namely:—

"155	PRINTING PAPER (excluding chrome, marble, flint, poster and stereo), all sorts which contain no mechanical wood pulp or in which the mechanical wood pulp amounts to less than 65 per cent. of the fibre content.	Pound	One anna.
156	WRITING PAPER— (a) Ruled or printed forms (including letter paper with printed headings) and account and manuscript books and the binding thereof.	Pound	One anna or 15 per cent *ad valorem* whichever is higher.
	(b) All other sorts	"	One anna."

[*Indian Trade Journal, 29th September, 1927.*]